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Retaining Excellence in U.S. Research Universities

In a series of upcoming Q&A sessions, academics and other observers will review the fiscal and competitive challenges facing U.S. research institutions and what might solve them.

By Ken Stier

State support per student is lower than it has been for 25 years, and private college endowments are not expected to recover to pre-crash levels for another 10-15 years.

The same week that President Obama called for the United States to regain its lead as the world's best-educated nation, the University of California system turned away 30,000 students.

This was roughly two years ago, but since then the fiscal picture has only darkened — for the federal government as well on the state level. The Golden State labors under a particularly gargantuan deficit — and the regents of the University of California responded by raising tuition a second time this year — but its predicament is emblematic of a central challenge for higher education across the United States. Just as alarming is the precipitous, and concomitant, decline in research taking place at the nation's major universities, public and private.

Stimulus money from the American Recovery Act has delayed the wrenching changes ahead, but the telltale signs are clear. State support per student is lower than it has been for 25 years, and private college endowments are not expected to recover to pre-crash levels for another 10-15 years, according to informed reckonings. Similar reckonings surround research at public institutions.

This comes as other nations rev up their commitment to higher education and research institutions.

China now spends 2 percent of its gross domestic product on research and development and has, in just the last five years, more than doubled the number of higher education institutions; the student population has surged from 1 million to 5 million during the same period. China is now the world's largest generator of scientific papers (quality is another matter, but these increasingly involve international collaboration).

Last November, China published its "National Patent Development Strategy (2011-2020)" that lays out ambitious plans to boost patent filings from 300,000 in 2009 to more than 2 million by 2015. China's patent surge, evident for several years, is stoked by government cash bonuses and better housing for individual filers and tax breaks for prolific patent-producing companies.

In the Middle East, credible efforts to stand up new world-class institutions include the $10 billion King Abdullah University of Science and Technology, which demonstrated its earnestness by recruiting highly regarded Harvard-trained academic Choon Fong Shih — who had already worked wonders at the National University of Singapore — as founding president. The university, Saudi Arabia's first mixed-sex university (even exempt from religious police patrols), uses English as the official language of instruction for programs focused exclusively on graduate education and research in life sciences, engineering, computer science and physical sciences.

Such new efforts will divert part of the geyser of international graduate students who have been a secret source of strength for American university research for years.

A National Academies of Sciences-assembled panel of experts, headed by former DuPont CEO Chad Holliday, has been asked: "What are the top 10 actions that Congress, the federal government, state governments, research universities and others could take to assure the ability of the American research university to maintain the excellence in research and doctoral education needed to help the United States compete, prosper and achieve national goals for health, energy, the environment and security in the global community of the 21st century?" The panel's progress to date can be seen here; it is expected to issue a report soon.

It's billed as an equally vital successor to the "Rising Above the Gathering Storm" study, a 2006 report that jolted Congress to pass the America COMPETES Act in 2007. That legislation aimed to revitalize American competitiveness through R&D-generated innovation, especially in "high-risk, high-reward research in areas of critical national need." (It was reauthorized in May 2010.)

Even before the new report arrives there is no escaping the shrunken universe American research universities occupy. There will be fewer research universities and narrower portfolios. Just how deep the cuts will bite — and their implications for government and the economy — are unclear.

The nation's spies, who have long benefited from the U.S.'s pre-eminent position in science and technology, suggest that the pain will be felt soon. "That the United States probably continues to dominate in some or most traditional areas of [science and technology] tends to mask the 'rate of closure' and to obscure the near certainty that in some very important areas we will soon lose our historic lead," read an Intelligence Science Board report penned in 2006 not but released until last year.

University-corporate partnerships, for one, will likely continue to strengthen in the U.S. (sharpening debates about its trade-offs), but increasingly globalized corporations likely will do more of this collaborative R&D overseas, especially as foreign universities proliferate and improved foreign knowledge levels offer more opportunities.

With many institutions already facing yawning needs (to replace crumbling or cramped infrastructure), some university presidents are clamoring for radical changes to federal support of higher education, for example, providing funds to institutions directly, rather than through individual faculty, and to pay the full cost of research. It remains to seen though whether many of these suggested remedies – discussed in more detail in the accompanying series of interviews with senior players in the university research field – will get the traction they need to travel far beyond cushy ivy towers. And political considerations — such Texas Gov. Rick Perry's attempts to re-engineer the University of Texas system — may play havoc with existing structures.

The consequences of these trends for the U.S., its global standing, – and the broader issue of research's role in solving the world's challenges – will be the focus of several question-and answer sessions with some of the academics and observers working to shape the challenging future that Miller-McCune.com will present as the traditional school year resumes.

http://www.miller-mccune.com/education/retaining-excellence-in-u-s-research-universities-34681/?utm_source=Newsletter173&utm_medium=email&utm_content=0809&utm_campaign=newsletters

Making Science Girl Friendly Pays Gender Dividends

A study in which the benefits of learning science were wrapped in issues traditionally associated with girls indeed generated more interest from the underrepresented sex.

By Kathy Seal

Getting girls interested science may require appealing to their feminine sensibilities, a researcher suggests. (Stockbyte)

If you want to interest girls in science, show how it will help them investigate stereotypically feminine concerns like caring for their skin and hair, says a just-published study in the *British Journal of Educational Psychology*.

After examining a wide array of science textbooks, University of Luxembourg educational researcher Sylvie Kerger concluded that most present real-world examples are "embedded in masculine contexts." But wrapping scientific subjects — at least initially — around female-friendly topics could kindle interest in scientific fields under-populated by women, Kerger says. Studies have shown that interest counts more than ability toward choosing a major or a career.

While women now constitute a sizable majority of U.S. college students — they received more than 57 percent of bachelor's degrees in 2008 — females earned fewer than 35 percent of degrees in science, technology, engineering and mathematics awarded that year, according to Linda J Sax, a professor of education at the UCLA.

Kerger gave 294 eighth- and ninth-grade boys and girls questionnaires asking them whether they would like to study biology, physics, information technology or statistics the following year. Instead of naming these subjects, the questionnaire presented each science through topics found in previous studies to be either male- or female-friendly. "How does a laser read a CD?" was a masculine way to ask about physics, while "how is a laser used in cosmetic surgery?" addressed stereotypical girls' concerns.

The youngsters rated their interest on a scale from one (not interesting at all) to five (very interesting). Presenting these sciences in a feminine way increased girls' interest in physics about a half-point, in information technology more than 0.75 of a point and in statistics more than a full point.

But the male-versus-female presentations didn't affect girls' interest in biology. ("Watch blood coagulate from a small wound," appealed to them as much as "reflect on how skin tanning comes about in the summer.")

"Girls are already very interested" in that science, even when presented in a male-friendly way, says Kerger.

Increasing the girl-friendly content had a predictable effect on boys' interest. When researchers couched information technology as learning "how to order clothes over the Internet" rather than figuring out "how the inside of the computer is structured," boys' interest dampened in that science.

Faced with this zero-sum result, Kerger and her colleagues don't argue for single-sex classes. This is a cross section, so while some girls aren't interested in stereotypically feminine topics, they point out, some boys are. The reverse also holds true. So they recommend teachers offer a choice among several modules dealing with the same scientific concepts wrapped around various male- and female-friendly topics.

Should we worry that addressing girls' stereotypical concerns, such as about their appearance, will validate and strengthen superficial interests?

Not really, said Kerger, because interests are already there. On the other hand, using any such initial interests to draw girls into science can reap dividends, because after activating initial interests – and the researchers acknowledge their work only showed how to cultivate initial interest in science, not how to sustain it — teachers can cultivate and maintain girls' scientific bent by tried and true methods. They include promoting cooperative group learning, giving students challenging opportunities to gain competence, and always pointing out the meaningfulness and relevance of scientific learning.

http://www.miller-mccune.com/education/making-science-girl-friendly-pays-gender-dividends-33777/

U.S. Middle Schoolers Are Behind in Math

A new study shows that the math curriculum of U.S. eighth-graders is two years behind what their peers in other countries are studying. In the U.S., the poorest students tend to get the least demanding math classes.

By Melinda Burns

Not adding up. A study reports that U.S. eighth-graders are behind classes in other countries in their math education — by a full two years. (istockphoto.com)

A new study of mathematics curricula and classroom content in 40 countries reveals that while most eighth-grade teachers are focused on algebra and geometry, their U.S. counterparts are teaching simple fractions, ratios, percentages and other topics that come up in the sixth grade internationally. Researchers at Michigan State University and the University of Oklahoma compared 37,000 American eighth-grade math students and 1,900 math teachers across nine states and 13 school districts with their peers in other countries, showing that the U.S. is two years behind in terms of math rigor. The fault lies with the decentralized U.S. educational system, the authors say — 15,000 local school districts in 50 states, each exercising *de facto* control over its own curriculum.

Writing in last month's issue of *American Journal of Education*, a research team headed by William Schmidt of Michigan State finds that family income is a heavier predictor of academic success in the U.S. than in most other countries. The higher the percentage of college-educated parents in an American school district, the tougher the math classes are likely to be. In other countries, all students get the same demanding curriculum.

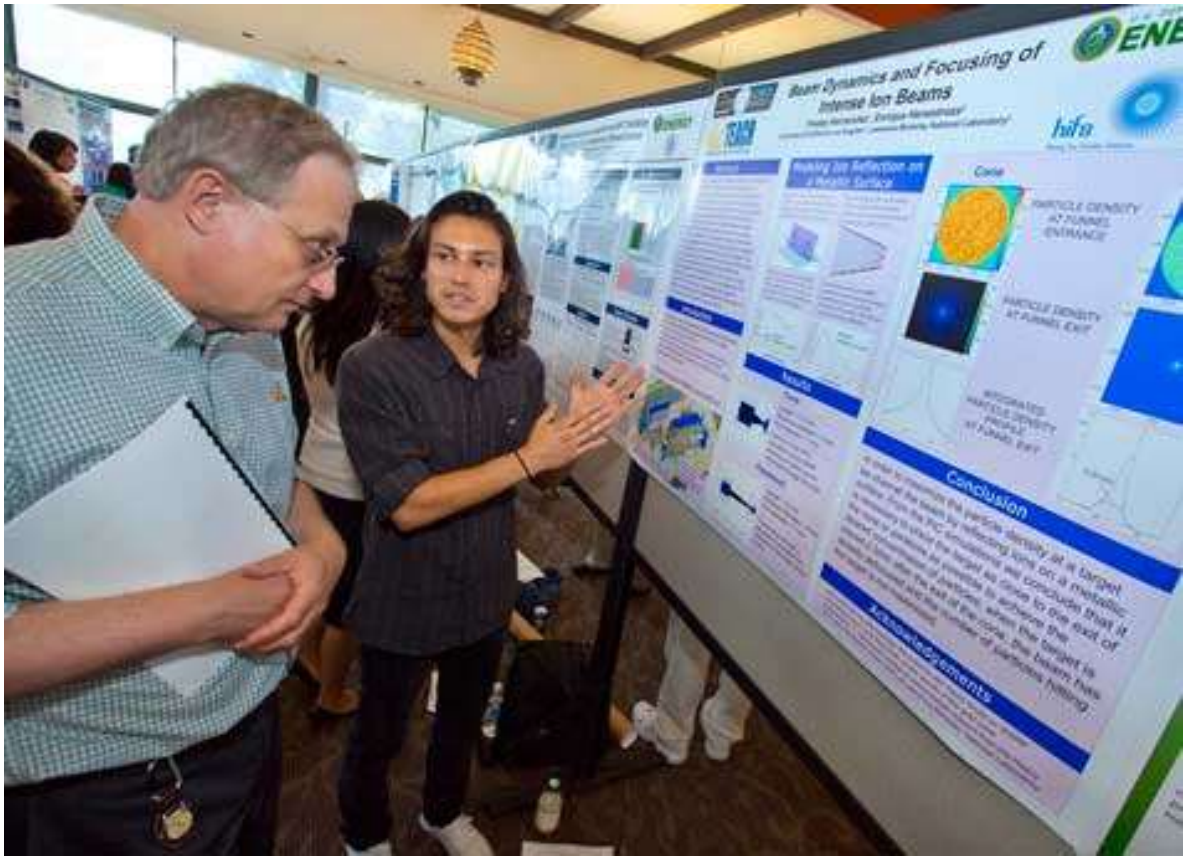
"America's schools are far from being the equalizers we, as a nation, want them to be," Schmidt says. But help is on the way. A math curriculum from kindergarten through 12th grade, developed by Schmidt and adopted by more than 40 states, will be in the classroom next year, with algebra beginning in seventh grade.

http://www.miller-mccune.com/education/u-s-middle-schoolers-are-behind-in-math-32384/

Science Posters Given a New Life Online

A cool new project dubbed Skolr promises to spread the latest science farther and faster by bringing science's ubiquitous poster sessions online.

By James Badham



Pictured, a "poster session" at The Lawrence Berkeley National Laboratory in 2009. A new project, dubbed Skolr, hopes to gather these kinds of posters found at conferences and workshops around the world and archive them in a searchable database. (Lawrence Berkeley National Laboratory)

Anyone who has spent time in academia or attended a scientific conference has seen them — the big plastic-laminated posters that are an indispensable element of science communication.

"Posters are a mass of good information," says Bruce Caron, a social anthropologist and the founder and executive director of the New Media Studio, a nonprofit that uses emerging multimedia technologies to explore the human environment. "They are an entire website, blog or Powerpoint put together on one page by people who are actively involved in research. They're a succinct representation of the most current information available."

Science posters are produced in great numbers. James Frew, a professor of geo-informatics at the University of California, Santa Barbara, calculates that roughly 250,000 posters are presented at academic professional meetings each year in the U.S. alone, representing some 4,000 person-years of production work. A single large academic meeting may have up to 10,000 posters.

But for all that work, the lifespan of the typical science poster is not much longer than that of a housefly, Caron says: "They are printed at the last minute, carried to the conference, presented for a few hours and then thrown away or put up on a back wall of a lab somewhere."

After a January poster event at a meeting of the Federation of Earth Science Information Partners, a group that seeks to improve access to, and uses of, Earth-science data, Caron had a realization. "Poster sessions are obligatory for many disciplines, but the inherent value of a poster is poorly served by a poster event," he says. "I thought we should capture the posters as PDF files, pop them into an archive, capture the abstract, add key words to make them easier to find, and make them available for people to see."

He presented the idea to Josh Greenberg, program manager at the Alfred P. Sloan Foundation, which has funded digital libraries and other projects related to the storage and accessibility of digital information.

"We started talking about how posters have greater value the more visible they are — particularly in a global sense," he recalls. "Say you're an ocean scientist in Africa and you can't make it to the annual American Geophysical Union meeting [one of the largest scientific conferences in the U.S.]. A searchable online database would allow you to browse the poster session and maybe find something valuable that you would not otherwise see."

In April, the Sloan Foundation provided grant funding for a pilot project called Skolr. The unusual spelling of what would be pronounced "scholar," Caron explains, is intended to enhance visibility to Web search engines. The program is being built using open-source software and will be field-tested at the FESIP meeting this summer. The project is receiving support from the New Media Studio, as well as the Carsey-Wolf Center for media studies at UCSB and DigitalOcean, a software platform designed to help scientists work more effectively together and with educators and policy makers.

It will work simply. At registration, presenters will be given a Web URL for poster registration. They'll then sign up, enter their poster abstract, the title, and the names of the authors and upload the poster as a PDF. Some keyword tagging will be added to enhance searchability, and the uploaded data will complement the physical display of the posters for that meeting. Posters captured by the system will be arranged by collection, associated with particular meetings.

Caron sees several benefits.

"It fits in to supporting digital organizations and other organizations with a social-media platform that allows people to share what they couldn't share before," he says. "It adds value to the meeting and to the hosting organization. It makes the posters easier to find, so the presenter gets more interest. Then you take that public, and that meeting has more value for the academy because you're exposing a tableau of current research that was obscured before."

Then there are the opportunities for enhancing interdisciplinary collaboration, a particular interest in the Earth sciences.

"What if there were a hundred meetings of various disciplines that all contributed posters to a searchable collection?" Caron posits. "You could start finding the crosscutting research connections between disciplines, even though people aren't in the same room, at the same meeting, or even in the same area of research. You can imagine an ocean-science researcher who has a project on a marine protected area in Hawaii being able to connect with a poster about the history of colonization on that island. It's a way to provide a larger purview of the activity of doing science. Or imagine you are a person who has a DigitalOcean profile, where you've created a map of your research region of interest, and every time a poster is created somewhere in the world that has content relevant to that, you receive an announcement on your Digital Oceans home page."

But while the software will extend the posters' life indefinitely, Caron doesn't want to alter what he calls the "quintessentially ephemeral nature" of posters.

"We have no intention of changing that," he says. "In other words, just because a poster is archived in a database, we don't want to say that it is now a 'publication.' It's still a poster. So in the software, we have given the presenter the ability to mark the poster as 'superseded,' meaning that the snapshot it represents is not current and may have been superseded by more recent findings. It's a snapshot in time. And people will also be able to remove a poster from the system."

http://www.miller-mccune.com/science/science-posters-given-a-new-life-online-34066/

Battling World Hunger Through Innovative Technology

From innovation in architecture and robotics to mobile apps and interactive games, technology is reshaping our understanding of and approach to world hunger.

By Miller-McCune Staff

For every question you answer correctly on FreeRice.com, the site donates 10 grains through the World Food Programme.

Topics like farm industrialization and genetic modification seem to dominate discussion of technology's role in addressing world hunger. Beyond them, however, are new and exciting frontiers. From mobile apps to interactive games, technology is reshaping our understanding of and approach to world hunger. To see the illustration of these innovations that appeared in the July-August 2011 issue of *Miller-McCune* magazine, click the image below.

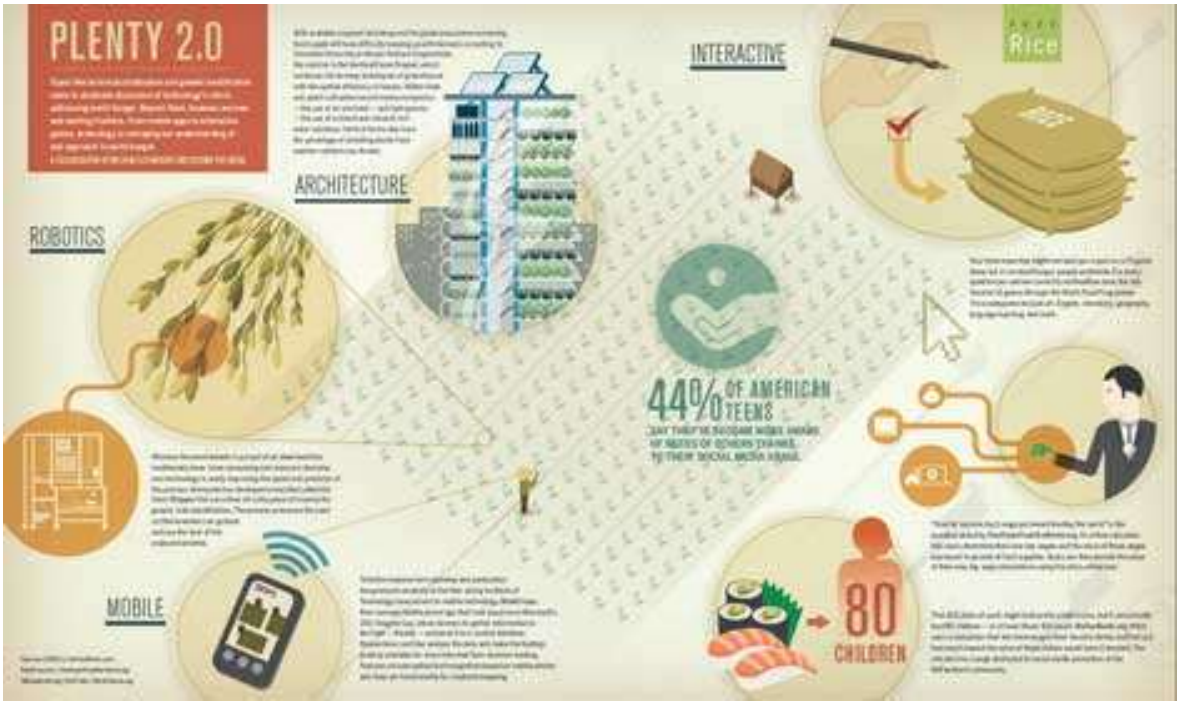
Robotics
Whereas the plant breeder's pursuit of an ideal seed has traditionally been time-consuming and resource-intensive, new technology is vastly improving the speed and precision of the process. Monsanto has developed a machine called the Corn Chipper that can shave off a tiny piece of a kernel for genetic trait identification. The process preserves the seed so that breeders can go back and use the best of the analyzed varieties.

Architecture
With available cropland shrinking and the global population increasing, food supply will have difficulty

keeping up with demand, according to Columbia University professor Dickson Despommier. His solution is the Vertical Farm Project, which combines the farming techniques of greenhouses with the spatial efficiency of towers. Rather than soil, plant cultivation would involve aeroponics — the use of air and mist — and hydroponics — the use of nutrient and mineral-rich water solutions. Vertical farms also have the advantage of shielding plants from weather-related crop threats.

Mobile Apps

To better improve farm planning and production, two graduate students at the New Jersey Institute of Technology have turned to mobile technology. MobiCrops, their concept mobile phone app that took top prize in Microsoft's 2011 Imagine Cup, allows farmers to gather information in the field — literally — and send it to a central database. Researchers can then analyze the data and make the findings publicly available for more informed farm decision-making. Features include optical leaf recognition based on mobile photos and drop-pin functionality from cropland mapping.



Interactive

Your trivia expertise might not land you a spot on a TV game show, but it can feed hungry people worldwide. For every question you answer correctly on FreeRice.com, the site donates 10 grains through the World Food Programme. Trivia categories include art, English, chemistry, geography, language learning and math.

"How far can one day's wage go toward feeding the world" is the question asked by OneDaytoFeedtheWorld.org. Its online calculator lets users determine their one-day wages and the value of those wages expressed in pounds of food supplies. Users can donate the value of their one-day wage calculations using the site's online tool.

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That $20 plate of sushi might look pretty small to you, but it can actually feed 80 children — or at least the $20 could. WeFeedback.org offers users a calculator that lets them plug in their favorite dishes and find out

how much impact the value of those dishes would have if donated. The site also has a page dedicated to social media promotion of the WeFeedback community.

This issue's Graphic Art was a collaboration between Miller-McCune and Column Five Media.

http://www.miller-mccune.com/science/battling-world-hunger-through-innovative-technology-33671/

Analyzing Culture with Google Books: Is It Social Science?

OPINION: Discovering fun facts by graphing terms found among the 5 million volumes of the Google Books project sure is amusing — but this pursuit dubbed 'culturomics' is not the same as being an historian.

By Anita Guerrini

"Culturomics" — linking cultural trends to quantitative analysis — is a nifty tool, but caution should be exercised when proponents of digital data encourage claims that it could make "much of what [historians] do trivially easy." (Hemera Technologies)

For more stories about all things Google, see the links at the end of this article.

Earlier this year, a group of scientists — mostly in mathematics and evolutionary psychology — published an article in *Science* titled "Quantitative Analysis of Culture Using Millions of Digitized Books." The authors' technique, called "culturomics," would, they said, "extend the boundaries of rigorous quantitative inquiry to a wide array of new phenomena spanning the social sciences and the humanities." The authors employed a "corpus" of more than 5 million books — 500 billion words — that have been scanned by Google as part of the Google Books project. These books, the authors assert, represent about 4 percent of all the books ever published, and will allow the kind of statistically significant analysis common to many sciences.

This sounds impressive. The authors point out that 500 billion words are more than any human could reasonably read in a lifetime. Their main method of analysis is to count the number of times a particular word or phrase (referred to as an n-gram) occurs over time in this corpus. (Try your own hand at n-grams here.) Their full data set includes over 2 billion such "culturomic trajectories." One of the examples the authors give is to trace the usage of the year "1951." They note that "1951" was not discussed much before the actual year 1951, that it appeared a lot in 1951, and that its usage dropped off after 1951. They call this evidence of collective memory.

I initially reacted to this article with skepticism. As I read more — including a recent piece (one might call it a puff piece) in *Nature* on one of the co-authors, Erez Lieberman Aiden, in which he was dubbed "the prophet of digital humanities" — my skepticism became stronger. I think culturomics is a nifty tool, but we need to be cautious and critical about this kind of digital data and about claims that culturomics could make "much of

what [historians] do trivially easy." Historians do much more than follow trajectories, so I am not so sure that culturomics will lead to a new way of doing historical work. It's not the game-changer it's been claimed to be.

I would not call myself a Luddite — I use digital resources all the time, in my research and my teaching. I have hundreds of PDFs of books I have downloaded from a variety of online sources — Early English Books Online, Eighteenth Century Collections Online, Gallica (the digital service of the French National Library), and yes, Google Books — that I use in my research.

But when I read the *Science* article, I was immediately struck by what seems to me to be a fundamental flaw in its methodology: its reliance on Google Books for its sample. Google Books has focused on digitizing academic libraries. I would argue that books found in academic libraries are not necessarily representative of cultural trends across society. As any historian knows, every scholarly library is different and every library has its biases. And surely I am not the only historian who has noticed that the digitizing policy of Google Books does not, and perhaps cannot, result in anything like a uniform, or a uniformly random, sample of all books in a given period. Google's ability to digitize books is dependent on a number of factors: the willingness of libraries to open their collections for digitization; the condition of the books being digitized; copyright regulations, which allow only "snippets" of many 20th-century books; and the quality of the digitization process itself.

The authors further narrow their range by admitting only publications for which they have "metadata" — that is, author, title, year, immediately confining the range of publications to books, and not periodicals or other more ephemeral literature — and to the period after 1800. The article itself gives no clue as to how the authors obtained this metadata. But surely it skews their data set even more toward a certain kind of book, while treating books as interchangeable pieces of data. In this universe, one book is much like another.

The authors equate size with representativeness and quantity of data with rigor. I am not sure that is true. I do not deny that some of their results are interesting, particularly the tracing of linguistic and grammatical changes over time, which is like watching a speeded-up newsreel. But some of the results are simply banal. The year "1951" appears most often in 1951. The word "slavery" appears more often during the U.S. Civil War. The word "influenza" appears more often during pandemics. Duh. Are these even historical questions?

Perhaps most disturbing to me is the underlying assumptions of such work about the humanities and about what scholars in the humanities do. One assumption is that the humanities need to be more like science and that we need to be more like scientists — that quantitative knowledge is the only legitimate knowledge and that humanities scholars are therefore not "rigorous." For well over a century, historians and their critics have debated whether their discipline is a science or an art. When the journal *Past and Present* was founded by a group of Marxist historians in the early 1950s, it was billed as "a journal of scientific history." By the mid-1960s this had changed to simply "a journal of historical studies." On the one hand, there are plenty of examples of humanities scholars who have been using sophisticated digital tools and quantification for years. The Cambridge population survey, with birth and death information gleaned from thousands of parish record books all over England, revolutionized social history when it began in the 1960s. When I was in graduate school in the 1980s, the SPSS statistical package could be mastered as an alternative to a second language. As cultural history became more prominent, quantitative history became less fashionable, but it never disappeared.

On the other hand, as these examples indicate, there is not just one kind of historical or, more broadly, humanities scholarship as the *Science* authors seem to think. Not all of us trace ideas over time. Some of us look at the people who had those ideas and the places they lived and worked, and the people they knew, and how they lived. Not all of this can be found in books but must be traced across a variety of published, manuscript and material media. Although the culturomics people are confident that they can apply their methods to manuscripts and maps, I'm not going to wait for that possibility.

Much like the digital versus the long-lost card catalog, such a sweeping tool leaves out the chance juxtapositions and serendipities that often tell us much more than the texts themselves. I spent many years off and on at the British Library reading advertisements in the microfilmed Burney collection of 18th-century newspapers. Now these have been digitized, and I can search for "anatomy lectures" and come up with dozens of hits that took me many eye-straining hours to find. But it cannot tell me that on the previous page, or in the previous issue, there was an ad for a patent medicine, or a live animal combat, or another fascinating bit of 18th-century London life that lends meaning and context to the bare entry.

It is revealing of another kind of bias that the long list of authors of the *Science* article includes no historians, in fact no one from the humanities (Louis Menand also pointed this out in an interview in *The New York Times*). To be fair, "R. Darnton" and "C. Rosenberg" (presumably the Harvard historians Robert Darnton and Charles Rosenberg) are thanked at the end. The *Nature* article goes out of its way to point out that Erez Lieberman Aiden studied history and philosophy and even creative writing, which is something like saying I took physics in college, and therefore I can publish on quantum mechanics in *Nature*. Both articles show a nearly complete lack of understanding of what historians and other humanities scholars actually do.

When Lieberman Aiden and his co-authors presented their findings at the meeting of the American Historical Association in January, AHA President Tony Grafton expressed cautious praise of this new tool. In the *Nature* article he sounds decidedly more anxious: "You can't help but worry that this is going to sweep the deck of all money for the humanities everywhere else."

Indeed.

http://www.miller-mccune.com/media/culturomics-an-idea-whose-time-has-come-34742/

Suing Over Jobs

August 11, 2011

For the last year, the Education Department and Congress have debated measures of "gainful employment" for graduates of for-profit vocational programs. And media outlets have competed for the best stories about unemployed liberal-arts graduates. But the question of whether higher education can be held responsible for failing to warn would-be students about the poor job prospects of graduates may really be taking off with regard to law schools.

On Wednesday, a New York City law firm filed class actions against two law schools -- New York Law School and Thomas M. Cooley Law School -- charging that the job placement information they released to potential students was sufficiently inaccurate as to constitute fraud. Those suits follow a similar one filed in May against Thomas Jefferson School of Law. All of the suits argue that students were essentially robbed of the ability to make good decisions about whether to pay tuition (and to take out student loans) by being forced to rely on incomplete and inaccurate job placement information. Specifically, the suits charge that the law schools in question (and many of their peers) mix together different kinds of employment (including jobs for which a J.D. is not needed) to inflate employment rates.

All three law schools deny the charges. And Cooley has already filed a defamation suit against the lawyers suing it. But the litigation comes amid a broader debate over whether the American Bar Association and others are doing enough to promote the release of accurate information, and whether there are too many law schools for the current job market.

While legal experts were still examining the lawsuits and were generally not ready to weigh in on whether or not they will succeed, several said that the litigation points to longstanding problems with how job placement has been tracked, and that changes currently under consideration are overdue.

"The fact that you have some serious class action law firms filing suit should give anybody pause," said William D. Henderson, a professor of law and director of the Center on the Global Legal Profession at Indiana University, and a frequent author on job placement issues. "The whole industry hasn't released useful numbers for consumers," he said.

Henderson said that he strongly backed current moves by the American Bar Association (likely to then be adopted by *U.S. News & World Report* for its rankings) to shift from a standard of being employed nine months after graduation to being employed in a job for which a J.D. is needed. Those suing today (and those in recent years who were disappointed by their success at finding jobs) relied on statistics that didn't exclude those whose "jobs" were fellowships paid for by their law schools, who were in part-time or temporary jobs, or who were in jobs they could have gotten before they went to law school, he said.

Several years ago, Henderson started noticing and writing about the seeming oddity that bar passage rates were declining at a time when law schools were reporting increases in employment of graduates. For this to be true, he speculated, more people were getting jobs that didn't require them to go to law school. "You are counting people who are selling insurance," he said. "Anybody can find a job to pay the rent."

The New Lawsuits

The new lawsuits are class actions on behalf of three graduates of New York Law School and four from Thomas Cooley. (Both are freestanding law schools.)

Jesse Strauss, one of the lawyers bringing the suits, said in a briefing for reporters Wednesday that he was not denigrating the quality of the legal education provided by the law schools, and that he knew good lawyers who were graduates of each institution. But he said that the information about job placement rates was deceptive. "This is more like a false advertising claim than a product liability claim," he said.

Strauss said that the deceptive information about job placement rates is "distorting the market." With better information, he said, some students wouldn't go to law school, and the population of new lawyers would shrink.

The lawsuit charges that the schools' methods of reporting their placement rates gave would-be students an inaccurate view of their likely outcomes.

"[T]he school during the class period claims that a substantial majority of its graduates -- roughly between 75 and 80 percent -- secure employment within nine months of graduation. However, the reality of the situation is that these seemingly robust numbers include any type of employment, including jobs that have absolutely nothing to do with the legal industry, do not require a J.D. degree or are temporary or part-time in nature," the suit against Thomas Cooley says. "Rather, if Thomas Cooley was to disclose the more pertinent employment statistic -- i.e., those graduates who have secured full-time, permanent positions for which a J.D. degree is required or preferred -- the numbers would drop dramatically, and could be well below 30 percent, if not even lower."

The suit against New York Law School states that it "blatantly manipulates" its placement statistics (which suggest that 92 percent of last year's class is employed). The suit says that the law school engages in numerous efforts to "pretty up" its statistics, such as including part-time work, and including the 5.6 percent of its employed graduates who are in temporary fellowships funded by the law school -- not in real jobs.

The law schools released statements that did not offer point-by-point rebuttals of the suits, but defended the integrity of their statistics. "To the extent the lawsuit challenges our post-graduation employment and salary statistics, we stand by our reporting to the National Association for Law Placement, and any claims that prospective students or our graduates have been misled or legally harmed by our reporting are simply baseless," said the statement from Thomas Cooley. (Even as the law school is being questioned over its job placement record, Thomas Cooley is expanding -- and this week announced plans to open a campus in Florida.)

A statement from New York Law School said: "These claims are without merit and we will vigorously defend against them in court."

The Broader Debate?

What's next in the debate over law placement and these legal cases is the subject of much debate. Officials from the ABA, the Association of American Law Schools and NALP: The Association for Legal Career Professionals did not respond to requests for comment on Wednesday. Privately, two law school officials expressed doubts about whether the class actions would succeed in court, but indicated that defending against them might be embarrassing for the law schools involved and for legal education generally.

For an example of the potential public relations challenges, consider the response of Thomas Jefferson to its class action. As reported in the blog Above the Law, Thomas Jefferson defended itself by noting that the *U.S. News* job placement figures on which the plaintiff relied were adjacent to figures in the magazine for the law school's bar passage rate. The law school's bar passage rate was lower and Thomas Jefferson's rate many years was "significantly lower" than the employment rate, the law school argues in its brief. So "any

reasonable reader" would know that meaningful numbers of the law school's graduating classes were not working as lawyers. The blog's headline for the post: "Is the Answer Worse Than the Allegations?"

While the three law schools that have been sued are not among the nation's most prestigious, the lawyers who sued on Wednesday stressed that they saw the issue as going well beyond those institutions. At the news conference, they pointed to a recent article in *The New Republic* that analyzed data from an unnamed "top 50" law school, suggesting that one-third of graduates reporting themselves employed are in part-time positions -- meaning that well under half of graduates of a recent class are employed in full-time permanent positions, not the healthy majority that the official statistics would suggest.

Kyle McEntee, executive director of Law School Transparency, a group that has critiqued job placement rates at many law schools, said he was not surprised by the lawsuits. "I think we are going to see more of them," he said.

He said that the moves by the ABA are in the right direction, but that his group wants to see even more information. Law School Transparency urges law schools to release, graduate by graduate, exactly what happens to each new lawyer (without their names). That way prospective students won't get deceived by averages that may be skewed by a few well-compensated lawyers, and will be able to distinguish between true stepping-stone positions (judicial clerkships, for example) and volunteer work that doesn't put someone on the fast track.

Will the ABA Reforms Work?

The proposed ABA surveys on employment deal with many of the criticisms that have been made of past data. For instance, they would ask specifically about whether positions are funded by the law school, whether positions are long term or short term, etc.

But there is controversy over whether these efforts will work. NALP, which has been the primary source of law school placement data, has expressed fears that law schools will no longer collect data for its surveys, and that it is better able than the ABA to analyze the data. (A limitation of NALP's data is that they are not available institution-by-institution, which is why *U.S. News*'s rankings, which include institutional data, have become so valued by law school applicants and so important to law schools.)

Henderson, of Indiana University, said that the ABA may unintentionally supplant NALP, and leave the law school world without anyone capable of truly analyzing the data. The ABA, he wrote in a recent column for *The National Law Journal*, "has a long track record of releasing mountains of data in a format that makes it very difficult to analyze the industry or make meaningful school-to-school comparisons."

With truly good data, he predicted, the law school market would change, with some law schools forced to improve their programs and with others disappearing.

But Henderson added that he's not certain that -- even with better data -- there won't be disappointed (and impoverished) law school grads in the years ahead. "You've got 22- and 23-year-olds who have an image of lawyers made by popular culture," he said. "They've never bought a house before, and now they can get a loan of over $100,000 to go to law school. This is not a group of people who are going to do rigorous due diligence on the decision to borrow."

— Scott Jaschik

http://www.insidehighered.com/news/2011/08/11/suits_challenge_veracity_of_job_placement_rates_at_3_law_schools

Hostile Witness

August 9, 2011

These days there are enough blogs on the theme that law school is a scam that there are multiple blogrolls on the subject, where readers can pick among First Tier Toilet!, Fluster Cucked, Subprime JD, Tales of a Fourth-Tier Nothing and more. Most of these blogs are run by law students or recent graduates frustrated by a lousy job market, student loan debt and a feeling that they were ripped off by their law schools.

Another unemployed lawyer blog probably wouldn't attract much attention, but these "scam" bloggers have been abuzz about the latest arrival on their blogrolls: a blog sharing many of their points of view, but written by a tenured law professor.

"I can no longer ignore that, for a very large proportion of my students, law school has become something very much like a scam," says the introductory post of the blog, Inside the Law School Scam. "Yet there is no such thing as a 'law school' that scams its students -- law schools are abstract social institutions, not concrete moral agents. When people say 'law school is a scam,' what that really means, at the level of actual moral responsibility, is that law professors are scamming their students."

The professor has gone on in subsequent posts to describe his law faculty colleagues as overpaid, and as inadequate teachers. "The typical professor teaches the same classes year after year. Not only that -- he uses the same materials year after year. I'm not going to bother to count -- this is law school after all, and we don't do empirical research -- but I bet that more than half the cases I teach in my required first-year course were cases I first read as a 1L 25 years ago. After all I use the same casebook my professor used. I even repeat some of his better jokes (thanks Bill)," says one post.

And that was followed by another criticizing the gradual decline in teaching loads of professors at law schools (a trend that has been documented elsewhere), and arguing that students are paying quite a bit for minimal teaching time and effort. Of his fellow law professors, he writes: "They are like the most burnt out teachers at your high school, if you went, as I did, to a middling-quality public school. But with this difference: the most burnt-out teachers at your high school still had to show up for work for seven hours a day. Also, they didn't get paid $200,000 (or even quite a bit more) per year. And you didn't pay $50,000 a year for the benefit of their talents."

And LawProf says he's just getting started.

The author identifies himself only as "a tenured mid-career faculty member at a Tier One school." He agreed to reveal his identity to *Inside Higher Ed,* and his description is accurate. He teaches at a law school that doesn't make the "top 10" lists, but that is generally considered the best in its state and is well regarded nationally. His C.V. shows plenty of scholarship and professional involvement. And while "LawProf" (as he calls himself) is disdainful of the prestige hierarchy of American law schools, he said in the interview that it was important for the law school world to hear from someone "at a better law school," because so many law professors write off the current complaints from new graduates "as the concerns of third-tier law schools, which don't matter."

The reality, LawProf said, is that while students at top law schools fare much better, the issues are present everywhere. "Students are unable to get the kinds of jobs they want, and they are having to go for jobs they didn't envision before, and they are feeling ripped off," he said.

"A lot of people are going to get mad at me," especially if they ever figure out who he is, which he expects will happen, LawProf said. And while he has tenure, he said he believed there would be repercussions for

speaking out as he is. "It's breaking a wall of silence," LawProf said. And he said that he believes he will be more frank by writing anonymously.

In terms of reforming legal education, LawProf said it could be much less expensive, which in turn would result in less of a need for students to borrow, and change the current dynamic in which new graduates face massive debts without good jobs.

A plan for change, he said, would be to ignore the rankings (which encourage the wrong kinds of behavior), to stop spending so much on "luxury" facilities for law schools "that have nothing to do with education," to cut the number of administrators, and to offer fewer legal clinics (which he said are expensive and hide the poor job law schools do of training people to be lawyers).

And in a reflection of how unpopular he would be with his colleagues if he went public, LawProf called for law professors to be paid much, much less. Law professors (along with those in fields such as medicine and business) typically earn much more than their faculty colleagues in other disciplines. LawProf said he earned about $170,000 last year -- nowhere near the top of the heap at his law school, but double what most tenured professors outside the law school earn at his institution.

The traditional argument made in defense of such salary levels is that law schools would lose their best talent to law firms. But LawProf said that was "a bunch of bullshit." He said that law schools regularly employ a limited number of top lawyers (at a fraction of their billable hour rates) to teach single courses, and could do more of this and thereby bring more real-world experience into law schools.

And as for the full-time academics, LawProf said that they enjoy benefits of not working in law firms: shorter hours, less pressure, the ability to pick their areas of interest -- all of which should make typical academic salaries appropriate. Law professors, he said, do things they like 95 percent of the time, and law firm lawyers do that 5 percent of the time. That is a choice of value, he said. "Why are we paying these academics twice as much as other academics?" he asked.

Michael A. Olivas, a law professor at the University of Houston who is president of the Association of American Law Schools (but who stressed that he was speaking for himself, not the organization), said that LawProf is welcome to return half of his salary if he is guilt-ridden.

Olivas said that "there is a small grain of truth in most of what he says," but that his portrayal of law professors is unfair and inaccurate. Olivas said that good law professors prepare for every meeting of every course, paying attention to changes in the law. He said that they routinely help not only current students, but alumni. And he said legal scholarship is valuable to academe and society. "It's unprincipled to walk into class unprepared," he said. "I would never do that. Most people would never do that."

The vision of law school presented by LawProf neglects the extent to which American legal education is seen as a model in the rest of the world, Olivas said. Models that are based on maximum efficiency in other countries lead to large classes, minimal professor-student contact, and no scholarship, he added, wondering whether LawProf would like such a set-up in the United States.

Olivas also criticized LawProf for writing anonymously. "To hide behind an anonymous blog is to create hearsay that doesn't even round up to gossip," he said. Making such criticisms in public, Olivas said, would create an opportunity for meaningful debate, including exploring whether LawProf's experiences at his law school are typical of the faculty members there, or of law professors in general.

LawProf said that the realities of legal education today require a "whistle-blowing approach" such as the one he is taking. Other professions -- such as medicine -- may be guilty of restricting entry and making training

quite expensive, but they tend to produce solid careers for those who graduate from medical school. "The cartel of legal education is not good at all at protecting law graduates, but it's very good at protecting the economic privileges of legal academia," he said. The reason he has joined the "scam bloggers" is that "they have figured out that we have a cartel that screws them and the public."

— Scott Jaschik

http://www.insidehighered.com/news/2011/08/09/tenured_law_professor_aims_to_expose_the_excesses_of_his_profession

Objecting to More Lawyers

June 21, 2011

While many pundits argue that law schools are doing a disservice to their students and graduates by training more lawyers than ever before for a job market that has taken a nosedive in recent years, a handful of colleges are taking steps in the opposite direction.

At least three law schools -- Touro Law Center and Albany Law School in New York and Creighton University School of Law in Nebraska -- have announced plans to shrink the size of their incoming classes over the the next few years. Creighton will drop from 155 students in the fall 2010 class to 135 next year and stay there. Albany will go from 250 in the fall 2010 class to 240 next year and 230 the following year. Touro administrators are seeking approval to shrink the class by 10 students a year for the next three years.

The announcements come at a time when law schools are facing the nearly constant refrain from outside observers, as well as students and grads, that they admit too many students at too high a cost for the job market to sustain, leaving many students with massive debt loads they cannot pay off. They also fall on the heels of several colleges and universities announcing that they would not move forward on proposed plans to build law schools. Both decisions buck a trend of the last decade, in which colleges and universities catered to more and more would-be lawyers.

While 150 fewer law students over the next three years won't likely have a huge impact on the job market, some think these actions might be the start of a new trend.

Administrators at the law schools dropping enrollment cite a variety of reasons for downsizing, including a structural change in the job market that makes enrolling as many students an irresponsible course of action. "It's more than just an immediate problem," said Ed Birmingham, associate dean for administration and finance at Creighton. "This is a long-term trend involving international practice, the outsourcing of work, demands on lawyers to become more efficient, and also we've had a debt issue."

While most law schools are still claiming high job-placement rates, those numbers don't seem to show up in other reports. A study by Northwestern University's law school estimated that since January 2008, about 15,000 attorney and legal staff jobs have disappeared from the nation's largest firms.

"It is the ethical and moral thing to do," said Lawrence Raful, dean of the Touro law center, in an interview with the *New York Law Journal*. "I don't think the [job] placement situation is going to turn around for a number of years and I think we are concerned about the ethics of turning out quite so many students in debt when we know that not everyone can get a job to pay off that debt."

But other administrators, law professors, and higher education observers all say there are more factors at work besides ethics. They say that a nationwide drop in applicants, pressure to improve rankings, and financial pressures all play into the decision to downsize.

Applications to law schools dropped about 11 percent this year after a spike last year. The reason behind this decline has been debated, with some individuals arguing that students took note of the grim job market and balked at taking out significant loans to pay for a legal education. Others argue that applications for law schools, like those for business schools, tend to be counter-cyclical. Individuals seek professional degrees when they don't think there could be better options in the workforce, and spike in recessions. Between 2008 and 2009, the number of individuals taking the LSAT jumped from 151,398 to 171,514, according to the Law School Admissions Council. But with some economic recovery in 2010, that number receded to 155,050.

Either way, a shrinking pool of applicants means there are fewer strong applicants to spread around to law schools that are not in the top tier. Accepting fewer students means a law school can be more selective, helping to improve its standing in rankings. Better-prepared students are more likely to end up passing the bar and getting jobs upon graduation -- also pertinent factors in rankings.

Birmingham said one major reason for Creighton's move was to maintain the quality of its incoming class. "By definition, the last 20 to get in would not be as qualified as the 20 before them," he said. He also added that enrolling fewer students opens up more resources, staff support and faculty attention for the remaining students.

Albany has been shrinking its enrollment since 2003, when it had a total of 800 students in the law school. "It was a new dean wanting to raise the school profile," said David Singer, a spokesman for the law school. "His vision was to become a smaller, more selective institution, and things will follow from there." The school's average LSAT score rose from 148 in 2003 to 155 in 2006.

John Yoo, a professor at the University of California at Berkeley, argued in a blog post that these law schools are simply trying to protect the value of the degree by making it more scarce. "Education is a product in the market, like any other," he wrote. "The producers (law schools) sell a service (a legal education) at a price (tuition) to consumers (students). If there is an oversupply of the product, or the demand falls, then the price should drop and eventually the quantity will fall until the market clears. I don't see anything so moral (or immoral) about it."

Regardless of why these law schools are choosing to shrink their enrollments, the decision could pose financial challenges for them. Law schools like Creighton, Touro, and Albany don't have state appropriations or large endowments to help cover costs, and are therefore heavily dependent on tuition revenue. Creighton charges about $31,000 a year for tuition. Albany and Touro both charge about $41,000.

As it shrank its enrollment between 2003 and 2006, Albany missed out on about $3 million in revenue that it would have taken in from tuition, Singer said. Administrators raised tuition and made cuts to non-academic services to compensate for some of that lost revenue. Singer said alumni also responded positively to the change and increased their gifts to the law school.

Birmingham said he and other Creighton administrators aren't worried about the financial ramifications of their decision, but they announced the change in enrollment size in a letter to alumni that also asked for donations. He said the law school has always had strong support from its alumni, and he thinks they will respond positively to this change.

There is some debate about the role that colleges should play in informing students about their job prospects and helping them find employment. Some colleges have hired more career advisers during the past few years to help their students find jobs upon graduation. Creighton established a program in which students spend a semester in Washington to help them develop connections and get firsthand experience.

But Birmingham said no number of career advisers can compensate for the lack of jobs requiring legal training in the current job market. "It's like hiring more rainmakers in the desert," he said.

— Kevin Kiley

http://www.insidehighered.com/news/2011/06/21/law_schools_shrink_enrollments_in_face_of_poor_job_market_fewer_applications

Sad News From Mata Ortiz

Hello all,

Unfortunately we have sad news from Mata Ortiz. Nicolas Quezada, the most influential artist in Mata Ortiz, after his brother Juan, passed away yesterday after a long illness.
Nicolas was one of the finest artists of all times in Mata Ortiz. He was always alongside his brother Juan Quezada and is credited for many innovations in Mata Ortiz pottery making.

His legacy continues on with his sons Leonel and Jose and the many students he taught and inspired.

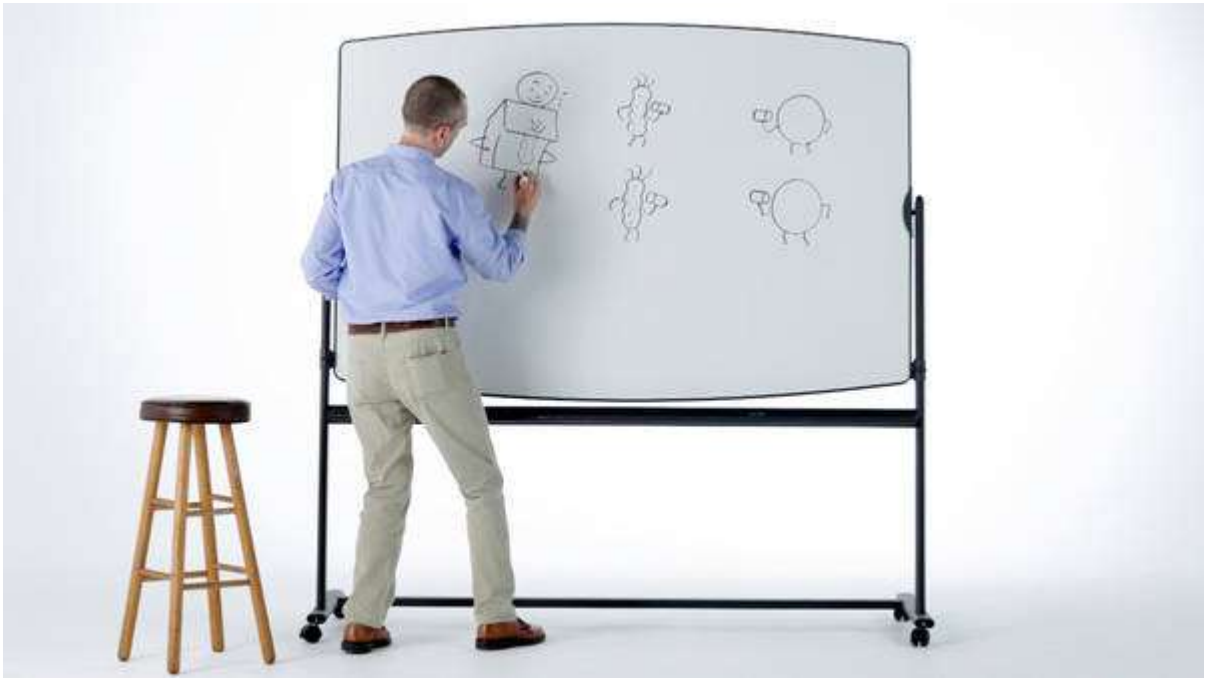
May

www.mataortiz.com

Shown above are some of the beautiful pieces by Nicolas Quezada that we had the fortune of having in our gallery.

4775 W Panther Creek DR # 440-103
The Woodlands, TX 77381

Cancer's Secrets Come Into Sharper Focus



By GEORGE JOHNSON

For the last decade cancer research has been guided by a common vision of how a single cell, outcompeting its neighbors, evolves into a malignant tumor.

Through a series of random mutations, genes that encourage cellular division are pushed into overdrive, while genes that normally send growth-restraining signals are taken offline.

With the accelerator floored and the brake lines cut, the cell and its progeny are free to rapidly multiply. More mutations accumulate, allowing the cancer cells to elude other safeguards and to invade neighboring tissue and metastasize.

These basic principles — laid out 11 years ago in a landmark paper, "The Hallmarks of Cancer," by Douglas Hanahan and Robert A. Weinberg, and revisited in a follow-up article this year — still serve as the reigning paradigm, a kind of Big Bang theory for the field.

But recent discoveries have been complicating the picture with tangles of new detail. Cancer appears to be even more willful and calculating than previously imagined.

Most DNA, for example, was long considered junk — a netherworld of detritus that had no important role in cancer or anything else. Only about 2 percent of the human genome carries the code for making enzymes and other proteins, the cogs and scaffolding of the machinery that a cancer cell turns to its own devices.

These days "junk" DNA is referred to more respectfully as "noncoding" DNA, and researchers are finding clues that "pseudogenes" lurking within this dark region may play a role in cancer.

"We've been obsessively focusing our attention on 2 percent of the genome," said Dr. Pier Paolo Pandolfi, a professor of medicine and pathology at Harvard Medical School. This spring, at the annual meeting of the American Association for Cancer Research in Orlando, Fla., he described a new "biological dimension" in

which signals coming from both regions of the genome participate in the delicate balance between normal cellular behavior and malignancy.

As they look beyond the genome, cancer researchers are also awakening to the fact that some 90 percent of the protein-encoding cells in our body are microbes. We evolved with them in a symbiotic relationship, which raises the question of just who is occupying whom.

"We are massively outnumbered," said Jeremy K. Nicholson, chairman of biological chemistry and head of the department of surgery and cancer at Imperial College London. Altogether, he said, 99 percent of the functional genes in the body are microbial.

In Orlando, he and other researchers described how genes in this microbiome — exchanging messages with genes inside human cells — may be involved with cancers of the colon, stomach, esophagus and other organs.

These shifts in perspective, occurring throughout cellular biology, can seem as dizzying as what happened in cosmology with the discovery that dark matter and dark energy make up most of the universe: Background suddenly becomes foreground and issues once thought settled are up in the air. In cosmology the Big Bang theory emerged from the confusion in a stronger but more convoluted form. The same may be happening with the science of cancer.

Exotic Players

According to the central dogma of molecular biology, information encoded in the DNA of the genome is copied by messenger RNA and then carried to subcellular structures called ribosomes, where the instructions are used to assemble proteins. Lurking behind the scenes, snippets called microRNAs once seemed like little more than molecular noise. But they have been appearing with increasing prominence in theories about cancer.

By binding to a gene's messenger RNA, microRNA can prevent the instructions from reaching their target — essentially silencing the gene — and may also modulate the signal in other ways. One presentation after another at the Orlando meeting explored how microRNAs are involved in the fine-tuning that distinguishes a healthy cell from a malignant one.

Ratcheting the complexity a notch higher, Dr. Pandolfi, the Harvard Medical School researcher, laid out an elaborate theory involving microRNAs and pseudogenes. For every pseudogene there is a regular, protein-encoding gene. (Both are believed to be derived from a common ancestral gene, the pseudogene shunted aside in the evolutionary past when it became dysfunctional.) While normal genes express their will by sending signals of messenger RNA, the damaged pseudogenes either are mute or speak in gibberish.

Or so it was generally believed. Little is wasted by evolution, and Dr. Pandolfi hypothesizes that RNA signals from both genes and pseudogenes interact through a language involving microRNAs. (These signals are called ceRNAs, pronounced "sernas," meaning "competing endogenous RNAs.")

His lab at Beth Israel Deaconess Medical Center in Boston is studying how this arcane back channel is used by genes called PTEN and KRAS, commonly implicated in cancer, to confer with their pseudotwins. The hypothesis is laid out in more detail this month in an essay in the journal Cell.

Fueled by the free espresso offered by pharmaceutical companies hawking their wares, scientists at the Orlando meeting moved from session to session and browsed corridors of posters, looking for what might have recently been discovered about other exotic players: lincRNA, (for large intervening noncoding), siRNA (small interfering), snoRNA (small nucleolar) and piRNA (Piwi-interacting (short for "P-element induced wimpy testis" (a peculiar term that threatens to pull this sentence into a regress of nested parenthetical explanations))).

In their original "hallmarks" paper — the most cited in the history of Cell — Dr. Hanahan and Dr. Weinberg gathered a bonanza of emerging research and synthesized it into six characteristics. All of them, they proposed, are shared by most and maybe all human cancers. They went on to predict that in 20 years the circuitry of a cancer cell would be mapped and understood as thoroughly as the transistors on a computer chip, making cancer biology more like chemistry or physics — sciences governed by precise, predictable rules.

Now there appear to be transistors inside the transistors. "I still think that the wiring diagram, or at least its outlines, may be laid out within a decade," Dr. Weinberg said in an e-mail. "MicroRNAs may be more like minitransistors or amplifiers, but however one depicts them, they still must be soldered into the circuit in one way or another."

In their follow-up paper, "Hallmarks of Cancer: The Next Generation," he and Dr. Hanahan cited two "emerging hallmarks" that future research may show to be crucial to malignancy — the ability of an aberrant cell to reprogram its metabolism to feed its wildfire growth and to evade destruction by the immune system.

Unwitting Allies

Even if all the lines and boxes for the schematic of the cancer cell can be sketched in, huge complications will remain. Research is increasingly focused on the fact that a tumor is not a homogeneous mass of cancer cells. It also contains healthy cells that have been conscripted into the cause.

Cells called fibroblasts collaborate by secreting proteins the tumor needs to build its supportive scaffolding and expand into surrounding tissues. Immune system cells, maneuvered into behaving as if they were healing a wound, emit growth factors that embolden the tumor and stimulate angiogenesis, the generation of new blood vessels. Endothelial cells, which form the lining of the circulatory system, are also enlisted in the construction of the tumor's own blood supply.

All these processes are so tightly intertwined that it is difficult to tell where one leaves off and another begins. With so much internal machinery, malignant tumors are now being compared to renegade organs sprouting inside the body.

As the various cells are colluding, they may also be trading information with cells in another realm — the micro-organisms in the mouth, skin, respiratory system, urogenital tract, stomach and digestive system. Each microbe has its own set of genes, which can interact with those in the human body by exchanging molecular signals.

"The signaling these microbes do is dramatically complex," Dr. Nicholson said in an interview at Imperial College. "They send metabolic signals to each other — and they are sending chemicals out constantly that are stimulating our biological processes.

"It's astonishing, really. There they are, sitting around and doing stuff, and most of it we don't really know or understand."

People in different geographical locales can harbor different microbial ecosystems. Last year scientists reported evidence that the Japanese microbiome has acquired a gene for a seaweed-digesting enzyme from a marine bacterium. The gene, not found in the guts of North Americans, may aid in the digestion of sushi wrappers. The idea that people in different regions of the world have co-evolved with different microbial ecosystems may be a factor — along with diet, lifestyle and other environmental agents — in explaining why they are often subject to different cancers.

The composition of the microbiome changes not only geographically but also over time. With improved hygiene, dietary changes and the rising use of antibiotics, levels of the microbe Helicobacter pylori in the

human gut have been decreasing in developing countries, and so has stomach cancer. At the same time, however, esophageal cancer has been increasing, leading to speculation that H. pylori provides some kind of protective effect.

At the Orlando meeting, Dr. Zhiheng Pei of New York University suggested that the situation is more complex. Two different types of microbial ecosystems have been identified in the human esophagus. Dr. Pei's lab has found that people with an inflamed esophagus or with a precancerous condition called Barrett's esophagus are more likely to harbor what he called the Type II microbiome.

"At present, it is unclear whether the Type II microbiome causes esophageal diseases or gastro-esophageal reflux changes the microbiome from Type I to II," Dr. Pei wrote in an e-mail. "Either way, chronic exposure of the esophagus to an abnormal microbiome could be an essential step in esophageal damage and, ultimately, cancer."

Unseen Enemies

At a session in Orlando on the future of cancer research, Dr. Harold Varmus, the director of the National Cancer Institute, described the Provocative Questions initiative, a new effort to seek out mysteries and paradoxes that may be vulnerable to solution.

"In our rush to do the things that are really obvious to do, we're forgetting to pay attention to many unexplained phenomena," he said.

Why, for example, does the Epstein-Barr virus cause different cancers in different populations? Why do patients with certain neurological diseases like Parkinson's, Huntington's, Alzheimer's and Fragile X seem to be at a lower risk for most cancers? Why are some tissues more prone than others to developing tumors? Why do some mutations evoke cancerous effects in one type of cell but not in others?

With so many phenomena in search of a biological explanation, "Hallmarks of Cancer: The Next Generation" may conceivably be followed by a second sequel — with twists as unexpected as those in the old "Star Trek" shows. The enemy inside us is every bit as formidable as imagined invaders from beyond. Learning to outwit it is leading science deep into the universe of the living cell.

http://www.nytimes.com/2011/08/16/health/16cancer.html?_r=1&nl=health&emc=healthupdateema2

For Some in Menopause, Hormones May Be Only Option

By TARA PARKER-POPE

Stuart Bradford

For women hoping to combat the symptoms of menopause with nonprescription alternatives like soy and flaxseed supplements, recent studies have held one disappointment after another.

Last week, a clinical trial found that soy worked no better than a placebo for hot flashes and had no effect on bone density. That followed a similar finding about hot flashes from a clinical trial of flaxseed.

"We wish we could have told women that, yes, they work," said Dr. Silvina Levis, director of the osteoporosis center at the University of Miami, who led the soy study. "Now we have shown that they don't."

Before 2002 women were routinely treated with the prescription hormones estrogen and progestin, which rapidly fell out of favor after the landmark Women's Health Initiative study showed that older women who used them had a heightened risk of heart attacks and breast cancer.

But now some doctors are arguing that those risks do not apply to the typical woman with menopause symptoms, and even some longtime critics of hormone treatment are suggesting that it be given another look for women suffering from severe symptoms.

Study after study has shown that many nondrug treatments — black cohosh, red clover, botanicals, and now soy and flaxseed — simply don't work. Prescription medicines, including antidepressants, the blood pressure drug clonidine and the seizure drug gabapentin may have some benefit, but many women cannot tolerate the side effects.

"There is no alternative treatment that works very well, whether it's a drug or over-the-counter herbal preparation," said Dr. Deborah Grady, associate dean for clinical and translational research at the University of California, San Francisco.

About 75 percent of menopausal women experience hot flashes. Depending on the woman, symptoms can be mild, occurring only a few times a week, or moderate, occurring several times a day. Many women with mild to moderate symptoms cope without needing further treatment. But about a third of women have severe symptoms, experiencing 10 to 20 hot flashes day and night that disrupt their workdays and interfere with sleep.

While doctors often reassure women that it will all be over in just a few years, a May report in the journal Obstetrics and Gynecology found that during one long-term study of women, menopausal hot flashes recurred for some women, for 10 years or more.

A hot flash is usually described as a sudden warmth first felt in the face and neck. Hot flashes can turn a woman's face red and lead to excessive sweating and then chills. On the Web site MinniePauz.com, women describe feeling lightheaded and dazed, with heart palpitations and anxiety.

"Whoosh, a rush of heat originating from the core of your body," is how one woman put it. "Hair goes lank and you know that even if you stripped naked and ran down the high street waving your arms to fan your body, well you still wouldn't get cool because the heat is inside you, not outside."

The exact cause of hot flashes is not known, but it is believed that menopause disrupts the function of the hypothalamus, which is essentially the body's thermostat. As a result, even small changes in body temperature that would normally go unnoticed can set off hot flashes.

Among prescription drug treatments, the most effective may be antidepressants, including Effexor, Paxil and Pristiq, which have been shown to reduce hot flashes by as much as 60 percent, doctors say. Antidepressants are particularly useful for women with breast cancer or blood-clot disorders who do not have the option of taking a hormone drug.

But some doctors say they are frustrated by the message given to many women that they must seek an alternative treatment to prescription hormones. Dr. Holly Thacker, director of the center of specialized women's health at the Cleveland Clinic, said that for many women the benefits of effective hormone treatment would outweigh the risks and that they should not be scared off from considering the drugs.

"It would be like telling someone with insulin-dependent diabetes that they should try to use other things besides insulin," she said. "I see women look to alternative agents and coming in with bags of things, and they have no idea what they are putting into their body. There has been so much misinformation, and they are confused."

Dr. Grady, a longtime critic of widespread hormone use, said doctors and women appeared to be less tolerant of risks associated with hormones than of those with other drugs, even though menopause symptoms can be just as intolerable as migraine pain or other health problems.

"Somehow we're quite willing to take a migraine drug with its associated adverse effects because it works so well, but we're not willing to take estrogen," she said. "We worry about the adverse effects associated with estrogen, but the important adverse effects are reasonably uncommon.

"The question is whether a woman is willing to trade off that risk for a very effective treatment for symptoms that are otherwise ruining her life."

http://well.blogs.nytimes.com/2011/08/15/for-some-in-menopause-hormones-may-be-only-option/?ref=health

Pathogens May Change, but the Fear Is the Same

By DONALD G. McNEIL Jr.

In "House on Fire: The Fight to Eradicate Smallpox," Dr. William H. Foege, one of the conquerors of the virus, describes a grotesque moment in the war: The last victim in Benin, in West Africa, is visited by several "fetisheurs" — witch doctors — seeking to harvest his scabs.

For a fee, fetisheurs performed inoculations, a medical practice common in Africa for centuries. Into a small cut in the arm of a healthy person, they would rub in a victim's powdered scabs. (The inoculee had about a 2 percent risk of dying, but a typical African epidemic was about 25 percent lethal.)

But when business was slow, fetisheurs would drum some up by starting outbreaks. Coating thorn branches with a paste of scabs and tucking them in doorways to scratch passers-by would do the trick.

One is reminded of a conspiracy theory that still haunts another fatal disease, AIDS: the notion that a top-secret cure exists but is kept suppressed by pharmaceutical companies because there is more profit in drugs taken for life.

To a doctor, all epidemics are objectively different. Viruses are not bacteria are not parasites. Transmission by sex is not transmission by sneeze or mosquito. But to the mortals they mow down, all epidemics are emotionally alike — an onslaught of fear, awe, repulsion, stigma, denial, rage and blame — and doctors would be foolish to forget that.

Three works circulating now — Dr. Foege's book, Larry Kramer's autobiographical play "The Normal Heart" and a movie, "Life, Above All," set in South Africa — remind us how fragile life looks when the miasma is still swirling around our nostrils.

That is, before our fear ebbs and we tumble back into indifference, as we have about swine flu, SARS and even AIDS.

One of the first things we forget is epidemics' power to alter history.

Many Americans know AIDS killed Rock Hudson, Arthur Ashe, Freddie Mercury and Rudolf Nureyev. Sad deaths, but not earth-shaking.

Most probably do not know that, as he delivered his Gettysburg Address in 1863, Abraham Lincoln was just coming down with smallpox, which in the next week nearly killed him in midwar.

Or that George Washington's most important tactical decision may have been to inoculate his army in 1777, knowing his British foes, already protected, might prevail if an epidemic in Boston kept spreading. Two years earlier, American troops weakened by the pox had lost the Battle of Quebec.

The autobiographical work by Dr. Foege, a former director of the Centers for Disease Control and Prevention and now an adviser to the Bill and Melinda Gates Foundation, describes the last days of the only human disease ever eradicated.

The others are about AIDS, first detected in 1981, the year after smallpox died. It has now killed more than 30 million people, and the toll grows yearly — except in the minds of average middle-class heterosexual white Americans, a group that has lost its fear of the disease, according to a recent survey by the Kaiser Family Foundation.

A revival of "The Normal Heart," by Mr. Kramer, an early AIDS activist, is now on a national tour. It opens in Greenwich Village in 1981, as it dawns on a few American doctors that something mysterious and terrible is afoot. The play is really a vehicle for Mr. Kramer's anger, a series of tirades by his stand-in, whose message is that gay men should stop defining their struggle for equal rights chiefly as the right to have promiscuous sex. It makes him unpopular, but as medical advice it is sound: Avoid vectors of fatal illnesses, no matter how cute they are.

"Life, Above All," by contrast, is set in rural South Africa in 2010. It opens with a 12-year-old girl meeting an older man. Once you realize he is kindly, you are horrified to grasp why she is there: Her mother, paralyzed by grief, has sent her to buy a coffin for her baby sister.

The word "AIDS" is almost never said aloud in the film. Instead there are sidelong accusations, the bluntest being the baby's drunken father snarling at his wife, "You poisoned her with your milk."

Like "The Normal Heart," it exploits the shock value of symptoms American doctors rarely see anymore: the purple blooms of Kaposi's sarcoma, the white foam of oral thrush, the meningitis stare.

Everyone dies miserably, pushed down holes or abandoned under trees. One scene recalls an event I covered in 1998: the death of Gugu Dlamini, a South African woman beaten to death by her neighbors for admitting on a Zulu radio station on World AIDS Day that she was infected.

However, unlike Mr. Kramer's play, it takes place in a time when AIDS tests and antiretroviral drugs are available, even in the small town where it is set. People ought to be embracing hope, but stigma and fatalism force them to die rather than get tested.

That should be unthinkable. But I was reminded of something I saw last summer just after a global AIDS conference in Vienna. My flight out, filled with conference attendees in a festive mood, was about to take off when an engine shot sparks. We were towed back to the gate, and for the next 12 hours the airline gave us one false hope after another. Finally, at 2 a.m., exhausted and cross, we were informed that a replacement plane had arrived, but the crew was now too tired to fly it, so we would be escorted to a hotel.

The activists from Africa shrugged with resignation and sank back down on the benches. The gay Americans absolutely exploded at the poor woman from the airline.

That, it struck me, was a metaphor for the epidemic. Angry, vocal Americans led by people like Mr. Kramer get $15,000-a-year drugs at government expense. Silent, fatalistic Africans do not, even when the price is a mere $100.

As far back as 1965, when he was a Lutheran missionary doctor in a Nigerian village, Dr. Foege noted the paralyzing fatalism of the poor, calling it "one of the great challenges in global public health."

So, he said, was superstition. He saw vaccination rejected in India because of the Hindu belief that smallpox was sent by the goddess Devi, and that thwarting it would enrage her.

Dr. Foege also showed how the stigma of smallpox could be as awful as the stigma of AIDS. Not because it was sexually transmitted — it was not — but because it was just so repellent.

Americans who have seen only measles or chickenpox have no idea: The pox could be so thick that victims looked spackled, with each pock oozing pus and blood. He described finding living sufferers in a Pakistani slum by their "dead-animal odor." Survivors were often so disfigured they had no hope of marriage.

But the smallpox lesson Dr. Foege has to teach that is most pertinent to AIDS is not about superstition or stigma, but about the hard-nosed science of epidemiology. The world's official eradication plan, when he joined the fray, was a disastrous flop. New tactics had to be found and relentlessly enforced.

In his case, mass vaccination had to be scrapped in favor of ring vaccination. And religious and political objections had to be shoved aside with the same vigor that fetisheurs were.

The same is true for AIDS — 30 years in, the global epidemic is still growing, and the American one, according to C.D.C. figures released Aug. 3, has been stuck for a decade at 50,000 new infections a year.

Voluntary testing has failed to reach an estimated 250,000 Americans who do not know they have the virus and are passing it on. Privacy laws are so powerful that the rights of the infected trump those of their victims.

And what coughing did for smallpox, lying does for AIDS.

A 2007 study by Columbia University scientists found that almost 60 percent of gay American men who knew they were infected and were still having unprotected anal sex did not mention it to all their casual partners. One can only imagine what a survey of prison rapists would find, or one of prison rape victims returning home. “Life, Above All” is a South African primer on what lies to tell the neighbors: flu killed my baby, my son in the city died in a robbery, my blood is healthy.

In 1966, when the global effort to eradicate smallpox was declared, there were fewer than 15 million cases left. There are now 34 million cases of H.I.V. infection. No one seriously discusses eradication. It’s not that the plan is a flop; it’s that there is no plan.

http://www.nytimes.com/2011/08/16/health/16epidemics.html?ref=health

Mistakes in Storage May Alter Medication

By WALECIA KONRAD

What does extreme heat do to medications? I found out while we were sweating out the recent heat wave in a lake cabin in New Hampshire and my 10-year-old son's allergies kicked up.

I gave him a dose of over-the-counter medicine that usually brings quick relief. But this time the drug had no effect. The same thing happened the next day, and the next.

When I returned home, I asked a pharmacist about it. Was my son becoming immune to this particular medicine? Were his allergies getting worse?

The pharmacist asked where I had stored his pills as the temperatures soared. On the bathroom shelf in the cabin, I said. And on the sweltering six-hour drive to the lake? The medicine was in my suitcase in the trunk of the car.

And that's when I learned this: No drug should be exposed to temperatures higher than 86 degrees. Some days the bathroom at our vacation house and certainly the trunk of the car were well above that mark.

Extreme temperatures can have a big effect on both prescription and over-the-counter drugs.

Pharmaceutical manufacturers recommend most of their products be stored at a controlled room temperature of 68 to 77 degrees, said Skye McKennon, clinical assistant professor at the University of Washington School of Pharmacy. In truth, that is the range in which manufacturers guarantee product integrity. Anywhere from 58 to 86 degrees is still fine, she said.

"During heat waves and cold spells, storage locations can go above or below those ranges, causing medicines to physically change, lose potency or even threaten your health," Dr. McKennon said.

For patients with such chronic illnesses as diabetes or heart disease, a damaged dose of a crucial medicine, like insulin or nitroglycerin, can be life-threatening. But even common medicines can break down with potentially harmful effects, and you can't always tell by looking at the pill or liquid that a problem has occurred, said Janet Engle, a pharmacist and past president of the American Pharmacists Association.

When some antibiotics decay, they can cause stomach or kidney damage, Dr. McKennon said. Compromised aspirin can cause more than the usual stomach upset. Hydrocortisone cream can separate and become useless in the heat.

Any type of diagnostic test strip, like those used to test for blood sugar levels, pregnancy or ovulation, is extremely sensitive to humidity. If moisture sticks to the strips, it will dilute the test liquid and possible give a false reading.

Thyroid, birth control and other medicines that contain hormones are especially susceptible to temperature changes. These are often protein-based, and when protein gets hot it changes properties. "Think of an egg," Dr. McKennon said. "When it gets hot, it cooks."

Special care should also be taken with insulin, seizure medicines and anticoagulants, Dr. McKennon said. "Small changes in doses in some medicines like these can make a big difference to your health," she said.

Although it is hard to imagine freezing temperatures in the midst of August, keep in mind that cold can be a culprit, too. Drugs like insulin can lose their effectiveness if they freeze. The same goes for any so-called suspended medication that has to be shaken before use.

To make sure your medicines stay safe, here's some advice culled from pharmacists and other experts.

A COOL, DRY PLACE Despite the name, the medicine cabinet is often the worst place to store drugs because of the frequent high humidity in the bathroom. (Moisture is a particular menace for quick-dissolve tablets, the type my son was taking.)

Instead, save that space for bandages and toothpaste. Keep medicines in a cool, dry place, like a hallway linen closet, bedroom closet or even a kitchen cabinet away from the stove. If children or animals can get into these spaces, consider a higher shelf or lockbox.

SPECIAL PACKAGING Don't be lulled by expensive special packages designed to "protect" drugs, like a bubble or foil pack. There is no evidence that these packages protect medicine any better than a standard pill bottle, Dr. McKennon said.

That said, never take medicine out of the original packaging where it may be more exposed to the elements. One exception: Elderly or seriously ill patients often need day-by-day pill boxes to help keep their dosages accurate. These should be stored in a cool, dry place.

A special note about insulin: It can easily degrade if it is frozen or too hot, said Dr. Vivian Fonseca, a physician and president-elect of the American Diabetes Association. Unopened bottles of insulin are best kept in the refrigerator. Open bottles, however, can be kept at room temperature, which also makes injections more comfortable.

TRAVEL PRECAUTIONS Temperatures in a car can skyrocket while it is parked in a sizzling lot or driveway. That's why it is best to keep medicines in a purse or a separate bag when you travel. When you leave the car, take the medicines with you.

Take care during the hot summer months and frigid winter months if driving to the drugstore. Be sure to come straight home with the precious cargo.

"It's easy to assume you're going to come right home from the drugstore," Dr. Fonseca said. "But often you'll get distracted, run a few errands and the next thing you know it's an hour or two later. On an extremely hot day, that's not good."

If you need to store emergency medicines like an EpiPen or a dose of insulin in your car, ask your pharmacist to recommend a cool pack that will keep the specific medicine the correct temperature.

Always carry your medicines onto the airplane. Baggage holds are not controlled for temperature and can easily become freezing or scorching hot. Security procedures allow for carry-on medicines, but passengers may need to allow extra time for check-in.

DAMAGED DRUGS Never take any medication that has changed color or consistency, regardless of the expiration date. Check also for an unusual odor. Discard pills that stick together, are chipped or are harder or softer than normal.

Before discarding any medicine that you think may have been damaged by extreme temperatures, call your pharmacist. Some will replace the drugs free of charge. If the medicine was covered by an insurer, check with the company as well. It may reimburse you for a replacement dose.

Check with the manufacturer of the drug, too. Many have programs to replace certain damaged medicines.

Never flush unused medicines down the toilet, where they could make their way into the water supply. Instead, mix the pills or liquid with coffee grounds, cat litter or another material that makes them unpalatable, and put the mixture in the trash.

In addition, many states and municipalities have drug-collection programs where patients can take unused drugs to a community drop-off center for environmentally friendly disposal.

http://www.nytimes.com/2011/08/16/health/16consumer.html?ref=health

Panama Adding a Wider Shortcut for Shipping

By HENRY FOUNTAIN

COCOLÍ, Panama — For now, the future of global shipping is little more than a hole in the ground here, just a short distance from the Pacific Ocean.

Ah, but what a hole it is.

About a mile long, several hundred feet wide and more than 100 feet deep, the excavation is an initial step in the building of a larger set of locks for the Panama Canal that should double the amount of goods that can pass through it each year.

The $5.25 billion project, scheduled for completion in 2014, is the first expansion in the history of the century-old shortcut between the Atlantic and Pacific. By allowing much bigger container ships and other cargo vessels to easily reach the Eastern United States, it will alter patterns of trade and put pressure on East and Gulf Coast ports like Savannah, Ga., and New Orleans to deepen harbors and expand cargo-handling facilities.

Right now, with its two lanes of locks that can handle ships up to 965 feet long and 106 feet wide — a size known as Panamax — the canal operates at or near its capacity of about 35 ships a day. During much of the year, that can mean dozens of ships are moored off each coast, waiting a day or longer to enter the canal.

The new third set of locks will help eliminate some of those backlogs, by adding perhaps 15 passages to the daily total. More important, the locks will be able to handle “New Panamax” ships — 25 percent longer, 50 percent wider and, with a deeper draft as well, able to carry two or three times the cargo.

No one can predict the full impact of the expansion. But for starters, it should mean faster and cheaper shipping of some goods between the United States and Asia.

Dean Campbell, a soybean farmer from Coulterville, Ill., for instance, expects the expansion will help him compete with farmers in South America — which, he said, "has much poorer infrastructure for getting the grain out."

The canal expansion "will have a definite impact on us," Mr. Campbell said. "We think in general it will be a good thing, we just don't know how good."

Jean Paul Rodrigue, a professor of global studies and geography at Hofstra University who has studied the expansion project, said that the shipping industry was waiting to see how big the impact would be. "They know it's going to change things, but they're not sure of the scale."

For now the hole, parallel to the existing smaller Pacific locks and about a half-mile away, is a scene of frenetic activity by workers and machines laboring in the tropical haze. At one end, giant hydraulic excavators scoop blasted rock into a parade of earth movers that dump it topside on a slowly growing mountain of rubble. At the other, where the machines have finished their work, a pack of about 50 men buzzes over the rock floor, preparing it to serve as a foundation for a bed of concrete.

That slab will be one small building block for the immense structures to come: three 1,400-foot-long locks, water-filled chambers that will serve as stair steps, raising or lowering ships a total of 85 feet. An identical set of locks will be built on the Atlantic side.

Once an Atlantic-bound ship leaves the new Pacific locks, it would join the existing canal at the Culebra Cut — an eight-mile channel through the continental divide — and then steam across Gatún Lake to the new Atlantic locks for the trip back down to sea level. In all, the 51-mile passage will take about half a day, as it does now.

The expansion is being financed with loans from development banks to be repaid through tolls that currently reach several hundred thousand dollars for large ships. The project is huge by Panama's standards; among other things, the country's largest rock-crushing plant has sprung up, almost overnight, to turn the mountain of excavated rubble into sand and stone for the concrete.

It is hardly the biggest infrastructure project in the world, "but this is the one that has the most foreign impact," said Jorge L. Quijano, an executive vice president of the Panama Canal Authority, which has operated the canal since the United States handed it to Panama more than a decade ago. "And I think it is the one that has the most impact on the United States."

And perhaps on other nations: some of the largest ships that currently serve Europe by traveling through the wider Suez Canal in Egypt may begin using the Panama route.

But the impact will probably be greatest in the United States, the destination or origin of about two-thirds of the goods that pass through the canal.

Like the construction of the original canal, an engineering masterpiece that opened in 1914 after 10 years of work by the United States Army Corps of Engineers, the expansion project is a daunting task, but for different reasons.

The corps had to tackle tropical diseases that had killed thousands of workers during an earlier failed effort by the French. It had to excavate — and, crucially, dispose of — tens of millions of cubic yards of dirt and rock. And it built locks that were then the world's largest.

"They were the best engineers in the world, ever," said Alberto Alemán Zubieta, the chief executive of the canal authority. "Today I've got computers, technology, super equipment. Those guys did this in 10 years, under the most difficult conditions ever."

The biggest questions today concern whether, in a country and region marked by official corruption, the canal authority, an autonomous agency of the Panamanian government, can handle such an undertaking. Panama's vice president, Juan Carlos Varela, was reported to have privately called the project a "disaster" in 2009, according to an American diplomatic memo made public last year by WikiLeaks. Mr. Varela described the main contractors, Spanish and Italian firms, as "weak."

But authority executives say they have had nothing but support from the government. They claim that the project is on time and under budget, and that the authority has the engineering and management skill to complete it.

Some outsiders agree. "We are quite impressed with how the project is being run," said Byron Miller, a spokesman for the Port of Charleston in South Carolina, which is spending $1.3 billion over 10 years on improvements to handle the additional cargo from the canal and other routes.

Expansion of the canal was first proposed in the 1930s to accommodate large United States warships, and excavation for larger locks began in 1939 but was stopped during World War II. The current project was approved in a national referendum in 2006.

Deeper approach channels are being dredged on both coasts. And on the Pacific side, crews are excavating a long channel that will connect the new locks to the Culebra Cut. The channel through Gatún Lake is being widened so that larger ships can pass each other.

The new locks, which will account for about half the cost of the project, will work on the same principle used by the existing ones: moved solely by gravity, water is fed into or emptied from the chambers, raising or lowering the ships inside. But the new locks will use a different kind of gate at the end of each chamber, which should make maintenance easier and less disruptive. They will also have a feature found on some canals in Europe: three shallow basins next to each lock that will store water and reuse it. With the basins, the new locks will use about four million fewer gallons of water for each ship's passage through the canal than the much smaller existing locks. Even so, to ensure there is enough, the project will raise the level of Gatún Lake, which supplies the water for the locks, by about a foot and a half.

Water use would not seem to be much of an issue in rain-soaked Panama. But Gatún Lake serves as a drinking water supply as well. And the water level has to be monitored so there is enough stored for use by the canal during the dry season, roughly January to April. If the level is too low the authority has to reduce the amount of water for each passage, which means the deepest-draft ships cannot use the canal unless they unload some cargo.

Water quality is an issue as well. The new locks and basins will allow more saltwater into Gatún Lake, although the canal authority insists that the effect will be small and that steps can be taken to mitigate the problem if necessary.

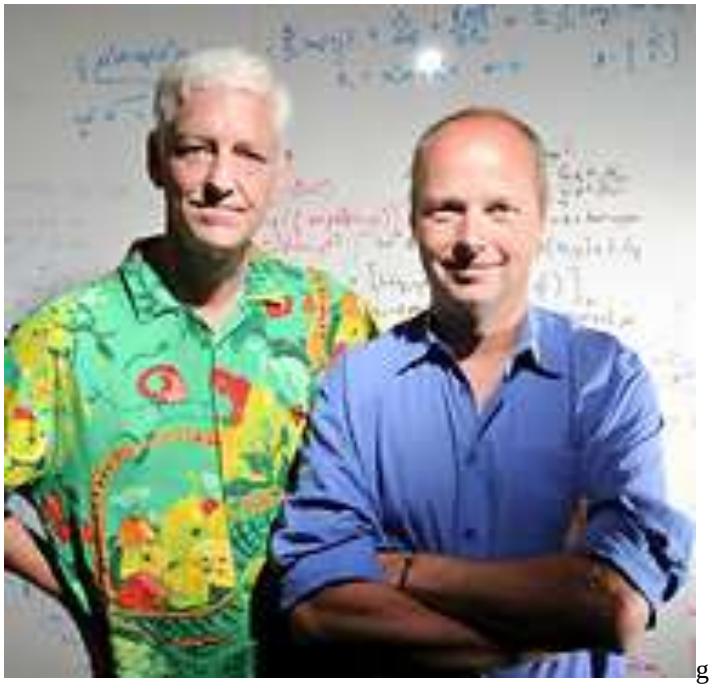
The water-saving basins, with an elaborate system of culverts and valves to divert water to and from the chambers, may be the project's most technologically challenging part. Operators will use computer controls that are a far cry from the electromechanical ones, with brass and glass indicators and chrome valve handles, that were used from 1914 until just a few years ago.

Despite the system's complexities, Mr. Quijano, the canal authority official, insisted that the authority was capable of carrying it out successfully. "We have not invented anything that has not been invented before," he said. Mr. Alemán, the authority's chief executive, also expressed confidence in the project's overall success, saying his managers draw lessons from those who worked a century ago. "We have a very high standard to live up to," he said.

http://www.nytimes.com/2011/08/17/science/17canal.html?ref=science

Virtual and Artificial, but 58,000 Want Course

By JOHN MARKOFF



PALO ALTO, Calif. — A free online course at Stanford University on artificial intelligence, to be taught this fall by two leading experts from Silicon Valley, has attracted more than 58,000 students around the globe — a class nearly four times the size of Stanford's entire student body.

The course is one of three being offered experimentally by the Stanford computer science department to extend technology knowledge and skills beyond this elite campus to the entire world, the university is announcing on Tuesday.

The online students will not get Stanford grades or credit, but they will be ranked in comparison to the work of other online students and will receive a "statement of accomplishment."

For the artificial intelligence course, students may need some higher math, like linear algebra and probability theory, but there are no restrictions to online participation. So far, the age range is from high school to retirees, and the course has attracted interest from more than 175 countries.

The instructors are Sebastian Thrun and Peter Norvig, two of the world's best-known artificial intelligence experts. In 2005 Dr. Thrun led a team of Stanford students and professors in building a robotic car that won a Pentagon-sponsored challenge by driving 132 miles over unpaved roads in a California desert. More recently he has led a secret Google project to develop autonomous vehicles that have driven more than 100,000 miles on California public roads.

Dr. Norvig is a former NASA scientist who is now Google's director of research and the author of a leading textbook on artificial intelligence.

The computer scientists said they were uncertain about why the A.I. class had drawn such a large audience. Dr. Thrun said he had tried to advertise the course this summer by distributing notices at an academic conference in Spain, but had gotten only 80 registrants.

Then, several weeks ago he e-mailed an announcement to Carol Hamilton, the executive director of the Association for the Advancement of Artificial Intelligence. She forwarded the e-mail widely, and the announcement spread virally.

The two scientists said they had been inspired by the recent work of Salman Khan, an M.I.T.-educated electrical engineer who in 2006 established a nonprofit organization to provide video tutorials to students around the world on a variety of subjects via YouTube.

"The vision is: change the world by bringing education to places that can't be reached today," said Dr. Thrun.

The rapid increase in the availability of high-bandwidth Internet service, coupled with a wide array of interactive software, has touched off a new wave of experimentation in education.

For example, the Khan Academy, which focuses on high school and middle school, intentionally turns the relationship of the classroom and homework upside down. Students watch lectures at home, then work on problem sets in class, where the teacher can assist them one on one.

The Stanford scientists said they were focused on going beyond early Internet education efforts, which frequently involved uploading online videos of lectures given by professors and did little to motivate students to do the coursework required to master subjects.

The three online courses, which will employ both streaming Internet video and interactive technologies for quizzes and grading, have in the past been taught to smaller groups of Stanford students in campus lecture halls. Last year, for example, Introduction to Artificial Intelligence drew 177 students.

The two additional courses will be an introductory course on database software, taught by Jennifer Widom, chairwoman of the computer science department, and an introduction to machine learning, taught by Andrew Ng.

Dr. Widom said she had recorded her video lectures during the summer and would use classroom sessions to work with smaller groups of students on projects that might be competitive and to bring in people from the industry to give special lectures. Unlike the A.I. course, this one will compare online students with one another and not with the Stanford students.

How will the artificial intelligence instructors grade 58,000 students? The scientists said they would make extensive use of technology. "We have a system running on the Amazon cloud, so we think it will hold up," Dr. Norvig said.

In place of office hours, they will use the Google moderator service, software that will allow students to vote on the best questions for the professors to respond to in an online chat and possibly video format. They are considering ways to personalize the exams to minimize cheating. Part of the instructional software was developed by Know Labs, a company Dr. Thrun helped start.

Although the three courses are described as an experiment, the researchers say they expect university classes to be made more widely accessible via the Internet.

"I personally would like to see the equivalent of a Stanford computer science degree on the Web," Dr. Ng said.

Dr. Widom said that having Stanford courses freely available could both assist and compete with other colleges and universities. A small college might not have the faculty members to offer a particular course, but could supplement its offerings with the Stanford lectures.

There has also been some discussion at Stanford about whether making the courses freely available would prove to be a threat to the university, which charges high fees for tuition. Dr. Thrun dismissed that idea.

"I'm much more interested in bringing Stanford to the world," he said. "I see the developing world having colossal educational needs."

Hal Abelson, a computer scientist at M.I.T. who helped develop an earlier generation of educational offerings that began in 2002, said the Stanford course showed how rapidly the online world was evolving.

"The idea that you could put up open content at all was risky 10 years ago, and we decided to be very conservative," he said. "Now the question is how do you move into something that is more interactive and collaborative, and we will see lots and lots of models over the next four or five years."

http://www.nytimes.com/2011/08/16/science/16stanford.html?ref=science

Three Waves of Evolutionary Innovation Shaped Diversity of Vertebrates, Genome Analysis Reveals

Fossil fish. (Credit: © psamtik / Fotolia)

ScienceDaily (Aug. 18, 2011) — Over the past 530 million years, the vertebrate lineage branched out from a primitive jawless fish wriggling through Cambrian seas to encompass all the diverse forms of fish, birds, reptiles, amphibians, and mammals. Now researchers combing through the DNA sequences of vertebrate genomes have identified three distinct periods of evolutionary innovation that accompanied this remarkable diversification.

The study, led by scientists at the University of California, Santa Cruz, and published this week in *Science*, focused on regulatory elements that orchestrate the activity of genes. They found three broad categories of evolutionary innovations in gene regulation that increased in frequency during different periods in vertebrate evolution. The first period, for example, was dominated by regulatory innovations affecting genes involved in embryonic development. These changes occurred during the period leading up to about 300 million years ago, when mammals split off from birds and reptiles.

"So many new body plans evolved during this time, it makes sense that the strongest signal in our analysis is for changes affecting genes involved in the development of the body plan and the complex regulation of other genes," said David Haussler, a distinguished professor of biomolecular engineering in the Baskin School of Engineering at UC Santa Cruz and corresponding author of the paper. First author Craig Lowe worked on the study as a graduate student in Haussler's group at UCSC and is now a postdoctoral researcher at Stanford University.

Many previous studies have shown that important evolutionary changes in animals have resulted from the gain, loss, or modification of gene regulatory elements, rather than from the evolution of new protein-coding genes. "Most of the changes that have happened during vertebrate evolution, as animals acquired new body plans and features like feathers and hair, were not the result of new genes but of new regulatory elements that turn genes on and off in different patterns," Haussler said.

The new study identified millions of these regulatory innovations by using computational methods to look for DNA sequences that are still the same in species that have evolved separately over long periods of time.

These sequences have presumably been conserved by natural selection because they serve an important function, so most mutations that change them would be harmful to the organism. Conserved sequences outside of known genes are likely to be gene regulatory elements. By comparing the genomes of species whose evolutionary lineages diverged at different times in the past, researchers can see when in evolutionary history a particular conserved sequence first appeared.

"These new regulatory elements are evolutionary innovations that have been passed on to all the descendants of the species in which they first arose," Haussler said. "We document millions of these events. We're not sure every one is rock solid, but we have so many that the statistical patterns are unequivocal--these trends must reflect the evolutionary changes that occurred."

The results reinforce the importance of gene regulation as a mechanism through which evolution occurs on the molecular level, he said. The findings also provide the first indication of distinct phases in vertebrate molecular evolution, with changes in different types of biological processes dominating during different periods of evolutionary history.

Because regulatory elements are typically located near the genes they govern, the researchers assigned each conserved element to the closest gene. They classified the genes into broad categories, such as developmental genes or genes involved in communication between cells, using information on gene functions available through the UCSC Genome Browser.

In the first period of evolutionary innovation, in addition to changes affecting developmental genes, the study found a dramatic enrichment in conserved elements near genes for proteins known as "transcription factors," which bind to DNA and regulate whole groups of other genes. New regulatory elements affecting transcription factors peaked in our early vertebrate ancestors 500 million years ago, then declined steadily to background levels by the time mammals evolved.

The next trend affected genes involved in cell-to-cell communication, such as genes for "receptor" proteins that sit in the cell membrane and receive signals from other cells. The increase in regulatory innovations near these genes occurred from about 300 million years ago to 100 million years ago and happened independently in the lineages of both fish and animals with "amniotic" eggs (birds, reptiles, and mammals).

A third trend showed up in placental mammals during the past 100 million years, when there was a rise in regulatory innovations for genes involved in signaling pathways within cells. These changes tweaked the complex cross-talk between molecules that coordinates all cellular activities.

Finally, the researchers took a close look at the well-studied set of genes associated with the development of body hair, a trait shared by all mammals. Several hundred genes are known to be involved in hair formation. "These genes have been around a long time, but if we look at the period about 250 million years ago when hair evolved in the predecessors of mammals, we see a bump in regulatory innovations near those genes," Haussler said. "It's not a stunning surprise, but it's a way of validating the method we used to measure regulatory innovation."

This method can be used to look for other evolutionary trends in particular lineages, especially as scientists sequence the genomes of more animals. Haussler, a Howard Hughes Medical Institute investigator and director of the Center for Biomolecular Science and Engineering at UCSC, is a cofounder of the Genome 10K Project, which aims to get genome sequences for 10,000 vertebrate species. With such a large number vertebrate genome sequences available for analysis, researchers will be in a position to discover the molecular basis for the evolutionary diversification of virtually all of the large animal species.

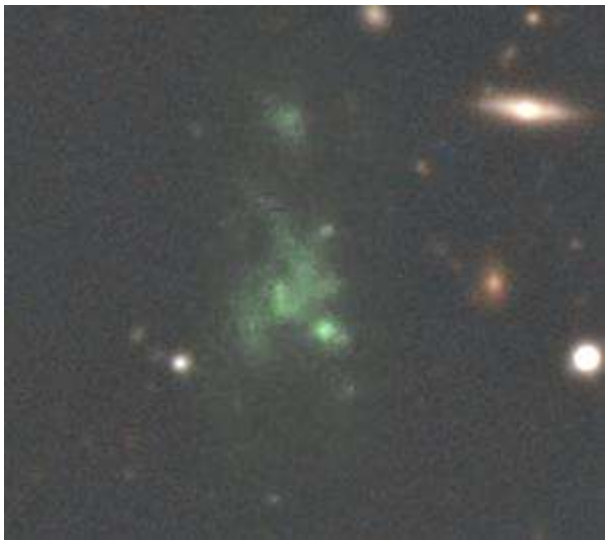
In addition to Haussler and Lowe, the coauthors of the Science paper include UCSC researchers Brian Raney and Sofie Salama; Manolis Kellis, Michele Clamp, and Kerstin Lindblad-Toh of the Broad Institute of MIT and Harvard; Adam Siepel of Cornell University, a former UCSC graduate student; and David Kingsley of Stanford University. This research was funded by the Howard Hughes Medical Institute, Sloan Foundation, and European Science Foundation.

Journal Reference:

1. C. B. Lowe, M. Kellis, A. Siepel, B. J. Raney, M. Clamp, S. R. Salama, D. M. Kingsley, K. Lindblad-Toh, D. Haussler. Three Periods of Regulatory Innovation During Vertebrate Evolution. *Science*, 2011; 333 (6045): 1019 DOI: 10.1126/science.1202702

http://www.sciencedaily.com/releases/2011/08/110818142738.htm

Giant Space Blob Glows from Within: Primordial Cloud of Hydrogen Is Centrally Powered



Giant space blob glows from within. (Credit: ESO)

ScienceDaily (Aug. 19, 2011) — Observations from the European Southern Observatory's Very Large Telescope have shed light on the power source of a rare vast cloud of glowing gas in the early Universe. The observations show for the first time that this giant "Lyman-alpha blob" -- one of the largest single objects known -- must be powered by galaxies embedded within it.

The results appear in the 18 August issue of the journal *Nature*.

A team of astronomers has used ESO's Very Large Telescope (VLT) to study an unusual object called a Lyman-alpha blob [1]. These huge and very luminous rare structures are normally seen in regions of the early Universe where matter is concentrated. The team found that the light coming from one of these blobs is polarised [2]. In everyday life, for example, polarised light is used to create 3D effects in cinemas [3]. This is the first time that polarisation has ever been found in a Lyman-alpha blob, and this observation helps to unlock the mystery of how the blobs shine.

"We have shown for the first time that the glow of this enigmatic object is scattered light from brilliant galaxies hidden within, rather than the gas throughout the cloud itself shining." explains Matthew Hayes (University of Toulouse, France), lead author of the paper.

Lyman-alpha blobs are some of the biggest objects in the Universe: gigantic clouds of hydrogen gas that can reach diameters of a few hundred thousand light-years (a few times larger than the size of the Milky Way), and which are as powerful as the brightest galaxies. They are typically found at large distances, so we see them as they were when the Universe was only a few billion years old. They are therefore important in our understanding of how galaxies formed and evolved when the Universe was younger. But the power source for their extreme luminosity, and the precise nature of the blobs, has remained unclear.

The team studied one of the first and brightest of these blobs to be found. Known as LAB-1, it was discovered in 2000, and it is so far away that its light has taken about 11.5 billion years to reach us (redshift 3.1). With a diameter of about 300 000 light-years it is also one of the largest known, and has several primordial galaxies inside it, including an active galaxy [4].

There are several competing theories to explain Lyman-alpha blobs. One idea is that they shine when cool gas is pulled in by the blob's powerful gravity, and heats up. Another is that they are shining because of brilliant objects inside them: galaxies undergoing vigorous star formation, or containing voracious black holes engulfing matter. The new observations show that it is embedded galaxies, and not gas being pulled in, that power LAB-1.

The team tested the two theories by measuring whether the light from the blob was polarised. By studying how light is polarised astronomers can find out about the physical processes that produced the light, or what has happened to it between its origin and its arrival at Earth. If it is reflected or scattered it becomes polarised and this subtle effect can be detected by a very sensitive instrument. To measure polarisation of the light from a Lyman-alpha blob is, however, a very challenging observation, because of their great distance.

"These observations couldn't have been done without the VLT and its FORS instrument. We clearly needed two things: a telescope with at least an eight-metre mirror to collect enough light, and a camera capable of measuring the polarisation of light. Not many observatories in the world offer this combination." adds Claudia Scarlata (University of Minnesota, USA), co-author of the paper.

By observing their target for about 15 hours with the Very Large Telescope, the team found that the light from the Lyman-alpha blob LAB-1 was polarised in a ring around the central region, and that there was no polarisation in the centre. This effect is almost impossible to produce if light simply comes from the gas falling into the blob under gravity, but it is just what is expected if the light originally comes from galaxies embedded in the central region, before being scattered by the gas.

The astronomers now plan to look at more of these objects to see if the results obtained for LAB-1 are true of other blobs.

Notes

[1] The name comes from the fact that these blobs emit a characteristic wavelength of light, known as "Lyman-alpha" radiation, that is produced when electrons in hydrogen atoms drop from the second-lowest to the lowest energy level.

[2] When light waves are polarised, their component electric and magnetic fields have a specific orientation. In unpolarised light the orientation of the fields is random and has no preferred direction.

[3] The 3D effect is created by making sure the left and right eyes are seeing slightly different images. The trick used in some 3D cinemas involves polarised light: separate images made with differently polarised light are sent to our left and right eyes by polarising filters in the glasses.

[4] Active galaxies are galaxies whose bright cores are believed to be powered by a vast black hole. Their luminosity comes from material being heated as it is pulled in by the black hole.

More information

This research was presented in the paper "Central Powering of the Largest Lyman-alpha Nebula is Revealed by Polarized Radiation" by Hayes et al. to appear in the journal *Nature* on 18 August 2011.

The team is composed of Matthew Hayes (University of Toulouse, France and Observatory of Geneva, Switzerland), Claudia Scarlata (University of Minnesota, USA) and Brian Siana (University of California, Riverside, USA).

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by European Southern Observatory - ESO.

Journal Reference:

1. Matthew Hayes, Claudia Scarlata, Brian Siana. Central powering of the largest Lyman-α nebula is revealed by polarized radiation. *Nature*, 2011; 476 (7360): 304 DOI: 10.1038/nature10320

http://www.sciencedaily.com/releases/2011/08/110817130957.htm

Romance vs. STEM

Photo: [n|ck]

August 16, 2011

When Lora Park was a graduate student in psychology at the University of Michigan, she used to hang out with a group of women in the physical sciences. And Park noticed that some of these exceptionally bright, academically successful women would hide their accomplishments from men they would meet, afraid of scaring them off.

Watching these scenes, Park wondered if women fear that they can't excel in math and science fields and also experience love. Park is now an assistant professor of psychology at the State University of New York at Buffalo. The journal *Personality and Social Psychology Bulletin* is about to publish a series of research projects she led, along with Buffalo graduate students, that suggest that when college-age women think about romance, they become less interested in studying STEM fields. College-age men, however, can get interested in romance without any impact on their engagement with math and science.

Park acknowledged that the research will be controversial -- and that many times when she presents findings to women in academe, they don't like talking about the role that something such as romance may play in the choices students make about what to study. But Park said that focusing on these questions could help confront the gender gap in STEM fields, which persists even as women have demonstrated that they have the academic preparation and ability to succeed in them.

Two of the studies were based on groups of students in an introductory psychology course; some of the students (based on prior surveys) were interested in studying STEM fields, and some were not. Participants were shown images related to love (images of romantic restaurants, sunsets at the beach, etc.) or images that related to "intelligence goals" (images of libraries, books, eyeglasses). Women who were exposed to the romantic images (but not the men exposed to the same images) were subsequently found in surveys to have a less positive feeling about STEM fields and to indicate that they were less likely to major in them.

Since that study and a similar one were based on external stimuli (the images seen in one case), the Buffalo researchers also did polling based entirely on students' self-reported feelings and interests.

In this study, female undergraduates in a mathematics course were given a mobile device on which they could record their strivings and activities in various areas, including romance and academics. They might note a crush, or calling someone they liked (romantically) or various academic accomplishments (related to finishing assignments, doing well in class, etc.). Likewise they answered questions about their senses of how attractive they found themselves.

The results: when the women were focused on romance, they felt good about themselves, but were not invested in their math class. And whenever they considered themselves attractive or desirable, the next day they would be disengaged from the math courses.So if bright, college-aged women can easily be discouraged from interest in STEM fields, what should be done? Park said that the first thing to do is to start talking about these issues, and to make clear that talking about them is not a matter of blaming women for their choices. "This is about the cumulative impact of romantic images and scripts for women's lives" that women are exposed to from very young ages, Park said.

Telling women "to be aware of these subtle influences" is important, Park said.Asked if her research suggests the value of women's colleges in that most women may have fewer romantic prompts on a daily basis, Park said that she had no data on the topic. Even if that is the case, she said, students at women's colleges are hardly isolated from societal influences. But she said that to the extent women's colleges are known to stress the importance of female academic achievement, that would have a positive effect. Likewise, she said much of the problem is related to a sense in traditional society that science is somehow masculine, and that men may be put off by women becoming a force in STEM fields. This should not be a factor at women's colleges.

She has several current projects going on to study ways that colleges might use "counter-stereotypes" to encourage women to stay in science. For instance, she said that she is looking at whether presenting young women with images not only of female scientists but of attractive female scientists may help. (There are some similarities between Park's recommendations and those of scholars who recently found that women in science are more likely than are men in academic science to regret not having more children. The scholars said that young scientists need role models of women who do have children and successful careers and that colleges need to provide mentoring about these issues.)

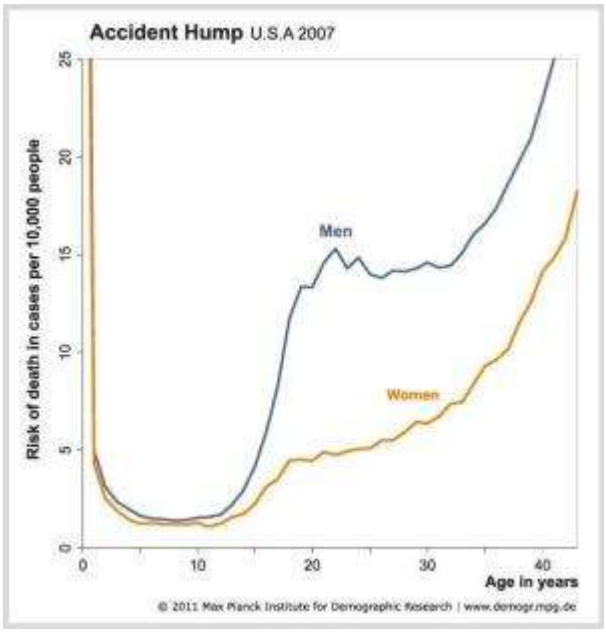
Park said that the key is to let women "think about their future possible self" not in ways that are dictated by "the script" they have picked up over the years, but by their potential.

Another area of research she is pursuing may or may not be helpful to her efforts, Park said. Since the assumptions of many women appear to be that men find female STEM success unattractive, she hopes to find out whether this is in fact the case.

— Scott Jaschik

http://www.insidehighered.com/news/2011/08/16/study_finds_that_exposure_to_romantic_ideas_discourages_college_women_from_studying_stem

Boys Reach Sexual Maturity Younger and Younger: Phase Between Being Physically but Not Socially Adult Is Getting Longer



Fatal Recklessness: With production of male hormones in puberty at its highest level, the probability for a boy in the United States to die in the year 2007 rose from 2 out of 10,000 at age 13 to more then the sevenfold at age 21 (i.e. 15 out of 10,000). (Credit: © MPIDR, Human Mortality Database / www.mortality.org)

ScienceDaily (Aug. 19, 2011) — Boys are maturing physically earlier than ever before. The age of sexual maturity has been decreasing by about 2.5 months each decade at least since the middle of the 18th century. Joshua Goldstein, director of the Max Planck Institute for Demographic Research in Rostock (MPIDR), has used mortality data to demonstrate this trend, which until now was difficult to decipher. What had already been established for girls now seems to also be true for boys: the time period during which young people are sexually mature but socially not yet considered adults is expanding.

"The reason for earlier maturity for boys, as with girls, is probably because nutrition and disease environments are getting more favourable for it," says demographer Joshua Goldstein. It has long been documented by medical records that girls are experiencing their first menstruation earlier and earlier. But comparable data analysis for boys did not exist. Goldstein resolved this gap by studying demographic data related to mortality. When male hormone production during puberty reaches a maximum level the probability of dying jumps up. This phenomenon, called the "accident hump," exists in almost all societies and is statistically well documented.

Goldstein discovered that the maximum mortality value of the accident hump shifted to earlier age by 2.5 months for each decade since the mid-1700s, or just over two years per century. Accordingly, the age of boys' sexual maturity decreased at the same rate. Essentially, the data showed that the age of sexual maturity is getting younger and younger since the accident hump is occurring earlier and earlier. (Research included data for Sweden, Denmark, Norway, Great Britain and Italy. Since 1950 the data is no longer clear but indicates stagnation.) The maximum of the accident hump occurs in the late phase of puberty, after males reach reproductive capability and their voice changes.

When boys get physically mature they take more risks and the risk of death increases

The accident hump, which also exists among male apes, occurs because young men participate in particularly risky behaviour when the release of the hormone testosterone reaches its maximum. Dangerous and reckless shows of strength, negligence, and a high propensity to violence lead to an increased number of fatal accidents. The probability remains low, but the rate jumps up considerably (see graphic).

In respect to the developmental stage of the body "being 18 today is like being 22 in 1800" says Joshua Goldstein. He sees the main causes as better nutrition and an improved resilience against diseases. Because the decline began long before the intervention of the automobile (accompanied by a high risk of accident) it appears that the shift in age of maturity is biological, and not related to technological advancements or social activities. When the use of automobiles or guns became common no significant effect on the data could be seen.

Albeit giving evidence for the age shift only indirectly via mortality data, Joshua Goldstein underlines the importance of its biological meaning: "Researchers see for the first time how females and males have been equally responsive to changes in the environment."

The onset of biological versus social adulthood is drifting apart

"The biological and social phases in the lives of young people are drifting apart ever stronger," says Josh Goldstein. "While adolescents become adults earlier in a biological sense, they reach adulthood later regarding their social and economic roles." Life cycle research shows that for more than half a century the age at which people marry, have children, start their careers and become financially independent from their parents continues to rise.

According to Joshua Goldstein, this doesn't only extend the period of physical adulthood during which young people do not yet have children. "Important decisions in life are being made with an increasing distance from the recklessness of youth." The demographer points out that it remains unclear whether the "high-risk phase" of adolescence becomes more dangerous for males because it starts earlier. While younger men are less mentally and socially mature, parents also tend to supervise their children more closely when they are younger.

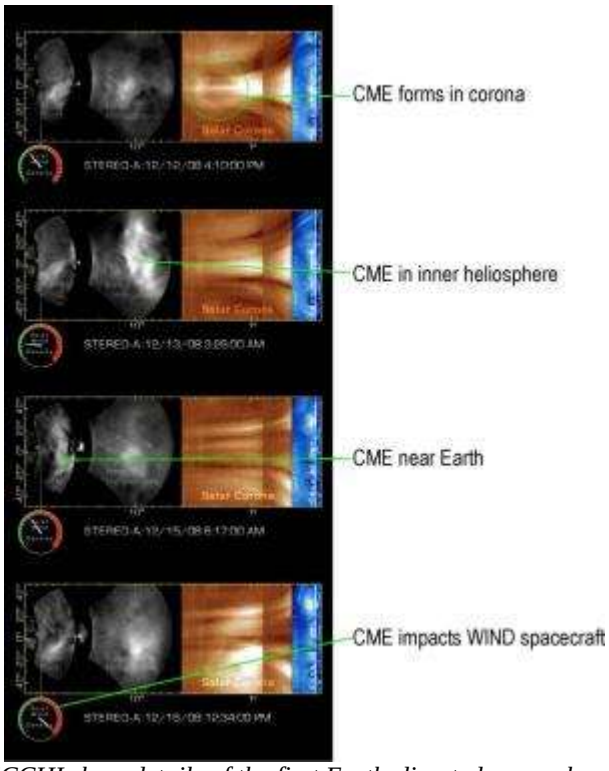
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by Max-Planck-Gesellschaft.

Journal Reference:

1. Joshua R. Goldstein. A Secular Trend toward Earlier Male Sexual Maturity: Evidence from Shifting Ages of Male Young Adult Mortality. *PLoS ONE*, 2011; 6 (8): e14826 DOI: 10.1371/journal.pone.0014826

http://www.sciencedaily.com/releases/2011/08/110818101714.htm

New Images Reveal Structures of the Solar Wind as It Travels Toward and Impacts Earth



Newly reprocessed archival data from STEREO-A/SECCHI show details of the first Earth-directed coronal mass ejection (CME) of the STEREO mission, from inception on December 12, 2008, to Earth impact on December 15, 2008. New processing enables following the details of the CME with the wide-field heliospheric imager cameras, out to impact with the Earth 93 million miles from the Sun. (Credit: Courtesy of SwRI/NASA)

ScienceDaily (Aug. 19, 2011) — Using data collected by NASA's STEREO spacecraft, researchers at Southwest Research Institute and the National Solar Observatory have developed the first detailed images of solar wind structures as plasma and other particles from a coronal mass ejection (CME) traveled 93 million miles and impacted Earth.

The images from a December 2008 CME event reveal an array of dynamic interactions as the solar wind, traveling at speeds up to a million miles per hour, shifts and changes on its three-day journey to Earth, guided by the magnetic field lines that spiral out from the Sun's surface. Observed structures include the solar wind piling up at the leading edge of a CME, voids in the interior, long thread-like structures, and rear cusps. Quiet periods show a magnetic disconnection phenomenon called a plasmoid, "puffs" that correlate with in-situ density fluctuations, and V-shaped structures centered on the current sheet -- a heliospheric structure in which the polarity of the Sun's magnetic field changes from north to south.

"For the first time, we can see directly the larger scale structures that cause blips in the solar wind impacting our spacecraft and Earth," said SwRI's Dr. Craig DeForest, lead author of an *Astrophysical Journal* article released online. "There is still a great deal to be learned from these data, but they are already changing the way we think about the solar wind."

"For 30 years," said co-author Dr. Tim Howard, also of SwRI, "we have been trying to understand basic anatomy of CMEs and magnetic clouds, and how they correspond to their source structures in the solar

corona. By tracking these features through the image data we can establish what parts of a space weather storm came from which parts of the solar corona, and why."

The team used a combination of image processing techniques to generate the images over a distance of more than 1 AU (astronomical unit), overcoming the greatest challenge in heliospheric imaging, that of extracting faint signals amid far brighter foreground and background signals. Small "blobs" of solar wind tracked by the team were more than 10 billion times fainter than the surface of the full Moon and 10 thousand times fainter than the starfield behind them.

"These data are like the first demonstration weather satellite images that revolutionized meteorology on Earth," said DeForest. "At a glance it is possible to see things from a satellite that cannot be extracted from the very best weather stations on the ground. But both types of data are required to understand how storms develop."

In particular, the new images reveal the shape and density of Jupiter-sized clouds of material in the so-called empty space between planets; in contrast, in-situ probes such as the WIND and ACE spacecraft reveal immense detail about the solar wind, at a single point in space.

Funding for this research was provided by the National Science Foundation SHINE Competition, the NASA Heliophysics Program and the National Solar Observatory by the U.S. Air Force under a Memorandum of Agreement. The paper, "Observations of Detailed Structure in the Solar Wind at 1 AU with STEREO/HI-2," by DeForest, Howard and S.J. Tappin (National Solar Observatory) was published online for the September 1, 2011 print issue of the *Astrophysical Journal*.

STEREO is part of NASA's Solar Terrestrial Probes Program in NASA's Science Mission Directorate in Washington. The program seeks to understand the fundamental physical process of the space environment from the Sun to Earth and other planets.

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

Journal Reference:

1. C. E. DeForest, T. A. Howard, S. J. Tappin. Observations of Detailed Structure in the Solar Wind at 1 AU with STEREO/HI-2. *The Astrophysical Journal*, 2011; 738 (1): 103 DOI: 10.1088/0004-637X/738/1/103

http://www.sciencedaily.com/releases/2011/08/110818142752.htm

The Dollar-Store Economy

By JACK HITT

Heather Mann writes a blog called Dollar Store Crafts, which evolved from her occasional trips to the extreme-discount dollar stores near her home in Salem, Ore. Her readers admire her gift for buying really cheap stuff and then making cool and beautiful things from the pile. Her knockoff "alien abduction lamp" is jury-rigged from a small light fixture, two plastic bowls (flying saucer), a clear acrylic tumbler (tractor beam) and a small plastic toy cow (abductee) — all purchased for about five bucks.

As we entered her favorite store, a Dollar Tree in Salem, Mann warned me that I'd have to hustle to keep up with her. "Look at these," she said. "Cute." Before I could even examine her find — a rack of smushy yellow chickens on sticks (plastic toy? Garden ornament? Edible peeps?) — she had ricocheted down another aisle, where I found her studying a prominent display garishly pushing a superabsorbent shammy. Mann noted that this was not the famously kitschy ShamWow! but a very cheap imitation called, merely, Wow. The display boasted, "As Seen on TV."

"As in, you've seen the *real* ad on TV," she said.

All around, the stacks of products and aisles of merchandise screamed a technicolor siren song. I found four AA batteries for my tape recorder for a dollar ($5.49 when I spotted them the next day at RadioShack), and dish towels that might have sold for $5 elsewhere were just a buck. Mann now brandished something called a "wineglass holder" the way Jacques Cousteau might have held up a starfish. It was a small aluminum device meant to clip onto your plastic picnic plate "for hands-free dining and socializing." At a price of four for a dollar, it's a good deal if your world is overrun with miserly wine connoisseurs.

When I looked up, Mann was already around the corner, having fun with a bottle of discount detergent boasting a "bingo bango mango" scent. Just up the way was a bin of brown bags marked either "A Surprise

for a Boy" or "A Surprise for a Girl." Mann's 5-year-old niece accompanied us on our tour and was crazed with excitement over these, and the truth is, we were all in the same exact mood. All around us, strange things hung here and there, urging us on an unending treasure hunt. Perhaps, like me, you have driven by and occasionally stopped in a dollar store and assumed that there were two kinds of customers, those there for the kitschy pleasure of it all — the Heather Manns of the world — and those for whom the dollar store affords a low-rent version of the American Consumer Experience, a place where the poor can splurge. That's true. But current developments in this, the low end of retail, suggest that a larger shift in the American consumer market is under way.

We are awakening to a dollar-store economy. For years the dollar store has not only made a market out of the detritus of a hyperproductive global manufacturing system, but it has also made it appealing — by making it amazingly cheap. Before the market meltdown of 2008 and the stagnant, jobless recovery that followed, the conventional wisdom about dollar stores — whether one of the three big corporate chains (Dollar General, Family Dollar and Dollar Tree) or any of the smaller chains (like "99 Cents Only Stores") or the world of independents — was that they appeal to only poor people. And while it's true that low-wage earners still make up the core of dollar-store customers (42 percent earn $30,000 or less), what has turned this sector into a nearly recession-proof corner of the economy is a new customer base. "What's driving the growth," says James Russo, a vice president with the Nielsen Company, a consumer survey firm, "is affluent households."

The affluent are not just quirky D.I.Y. types. These new customers are people who, though they have money, feel as if they don't, or soon won't. This anxiety — sure to be restoked by the recent stock-market gyrations and generally abysmal predictions for the economy — creates a kind of fear-induced pleasure in selective bargain-hunting. Rick Dreiling, the chief executive of Dollar General, the largest chain, with more than 9,500 stores, calls this idea the New Consumerism. "Savings is fashionable again," Dreiling told me. "A gallon of Clorox bleach, say, is $1.44 at a drugstore or $1.24 at a grocery store, and you pay a buck for it at the Dollar General. When the neighbors come over, they can't tell where you bought it, and you save anywhere from 20 to 40 cents, right?"

Financial anxiety — or the New Consumerism, if you like — has been a boon to dollar stores. Same-store sales, a key measure of a retailer's health, spiked at the three large, publicly traded chains in this year's first quarter — all were up by at least 5 percent — while Wal-Mart had its eighth straight quarterly decline. Dreiling says that much of Dollar General's growth is generated by what he calls "fill-in trips" — increasingly made by wealthier people. Why linger in the canyons of Wal-Mart or Target when you can pop into a dollar store? Dreiling says that 22 percent of his customers make more than $70,000 a year and added, "That 22 percent is our fastest-growing segment."

This growth has led to a building campaign. At a time when few businesses seem to be investing in new equipment or ventures or jobs, Dreiling's company announced a few months ago that it would be creating 6,000 new jobs by building 625 new stores this year. Kiley Rawlins, vice president for investor relations at Family Dollar, said her company would add 300 new stores this year, giving it more than 7,000 in 44 states.

And yet, how do dollar stores expand and make impressive returns, all the while dealing in an inventory that still largely retails for a few dollars? How does a store sell four AA batteries for $1? In part this market takes advantage of the economy degrading all around it. When I asked Dreiling about the difference in the cost of RadioShack batteries, he said that "RadioShack is probably in a better spot in the same shopping center," while Dollar General might be in a "C+, B site." RadioShack pays the high rent, while the dollar stores inhabit a "no-frills box."

The dollar-store combination has more to it than low store rents and really cheap products. The labor force needed to run a dollar store is a tiny, low-wage staff. Do the math of Dreiling's announcement: 6,000 jobs divided by 625 stores equals about 10 jobs per store.

Perhaps this is all merely our grandparents' Woolworth's five-and-dime updated by inflation to a dollar and adapted, like any good weed, to distressed areas of the landscape. But a new and eroding reality in American life underwrites this growing market. Yet even deep discounters have limits. In early June, Dollar General predicted that its sales growth would slow slightly for the rest of the year. Dreiling told analysts in a conference call that his company would be very careful about raising prices, even though its costs for fuel and such were rising. "This sounds almost silly," he said, "but a $1 item going to $1.15 in our channel is a major change for our customer." Such delicate price sensitivity suggests what is changing. Howard Levine, the chief executive of Family Dollar, said to me, although "not necessarily a good thing for our country, more and more people are living paycheck to paycheck."

Profit margins have always been thin in the dollar stores. But now that they are competing for the shrinking disposable income of the middle class, there is a new kind of consultant out there — the dollar-store fixer. Bob Hamilton advises the troubled independent-dollar-store manager on the tactics needed to survive and thrive in the dollar-store economy. One afternoon he drove me to Beaverton, Ore., to give me a tour of a Dollar Tree store whose layout and strategy he thinks is exemplary in its competitive cunning.

In Hamilton's view, the secret of a good dollar store is an obsessive manager who can monitor 8,000 to 10,000 items, constantly varying product display tactics, and sense the changing interests of a local customer base. This frenzied drama requires a sharp eye for tiny details. "The market is moving all the time," Hamilton said as we entered the store. Right away, he threw up his arms, thrilled. This was just before Easter, and he pointed out the big holiday display practically in the doorway, an in-our-face explosion of color and delight that herded us away from the exit. "The natural inclination is to move to the right," Hamilton said, nodding at the cash registers on the left. The hunt was on.

Hamilton pointed out that the aisles are about two inches wider than two shopping carts, which themselves are comically tiny, giving the buyer a sense that even a small pile of goods is lavish. Despite the dollar store's reputation for shoddy products, the mise-en-scène nevertheless suggests a kind of luxury, if only of quantity. "The first thing you feel is this thing is packed with merchandise," Hamilton said, pointing out the high shelves along the walls. Helium balloons strained upward, everywhere. Any empty wall space was filled with paper signage proclaiming savings or "$1" and framing the store's goods.

But wait! There, in the middle of the aisle, was a tower of candy boxes, razored open and overflowing with cheap sweets. "They do this a lot with facial tissue or back-to-school items," Hamilton said. But it was blocking the aisle — a deadly error in his view. Worse are the managers who deliberately create cul-de-sacs by closing off the back of an aisle with goods. "You have to turn around and come back!" Hamilton said, shaking his head in disbelief. "You just watch the customers, and they will skip the aisle, every one of them."

The idea, Hamilton explained, is to create a kind of primal experience and a certain meditative flow. "My theory was to get them in a pattern, and they will just go up and down and go, 'Oh, I forgot I need that,' and pick it up."

At one point in the tour, Hamilton spotted patches of bare shelf space and was practically ashamed. His model store was committing egregious mistakes. "This is probably the worst aisle we've been down," he whispered. He dashed to a single barren metal hook and pointed in horror. "They have an empty peg! People are thinking, I'm getting the last one!" The stuffed bins, the boxes on wood pallets sitting on the floor, the merchandise piled to the ceiling — all this breeds an excited sense that everything just got here and you're getting to it first.

"You always keep things full," he said. And always keep the higher part of the shelves engorged with product. "People buy at eye level," he added. Hamilton advised that products should be hung in vertical strips so that in a walk up the aisle, the eye can distinguish one item from the next. We arrived to a back wall covered

entirely in plastic, pillar after pillar of household cleaning supplies, a kaleidoscopic blaze of primary colors. Bob Hamilton was one happy man.

"Shopping is our hunting and gathering," says Sharon Zukin, a professor of sociology at Brooklyn College who specializes in consumer culture and suggests that the dollar-store experience is a mere updating of our evolutionary instincts. "This bare-bones aesthetic puts across the idea that there is nothing between you the consumer and the goods that you desire. You are a bargain hunter, and it's not like a bazaar or open-market situation in other regions of the world. It doesn't require personal haggling between the shopkeeper and the shoppers. Right? The price is set, and it's there for the taking. In many cases the cartons there have not been unpacked! You are getting the product direct from the anonymous large-scale producer. You have bagged the deer: you have your carton of 36 rolls of toilet paper."

As strange as sociological metaphors sound in this context, this is very close to how the corporate chain executives describe the next stage of dollar-store evolution, as they try to please their new, more affluent customer. Both Dollar General and Family Dollar are moving toward uniformity in their design and layout, throwing off the serendipity that came of buying random lots and salvage goods and was so admired by, say, crafts bloggers. The new design has opened up the front of the stores "for those whose trip is all about, 'I'm getting what I need and getting out,' " said Rawlins of Family Dollar. As a result, the design of the store is no longer catch-as-catch-can but built around groupings of products that all make sense for the mission-oriented hunter. Store designers call these groupings "adjacencies" and draw them up in fine detail in an architectural schematic called a planogram. Toys, wrapping paper and gift cards, for instance, are laid out in a logical sequence that has been revealed by elaborate customer research and designed with precision.

"A hundred percent of our stores are planogrammed," Dreiling of Dollar General says. "We used to have what was called 'flex space,' and 25 percent of the store was where the store manager could put in whatever they wanted." No more. "Everything is planogrammed now."'

"Today we have very little in terms of closeouts," said Family Dollar's Rawlins. "Forty-five percent of our merchandise are national brands that we carry every day." Even though the goods are still deeply discounted, the stores will begin to have a similar look and layout — like the higher-end stores already do. Same inventory, same layout, same experience — from coast to coast.

As all these stores expand into really cheap food, they are creating their own store brands. Just as A.&P. long ago, or Target more recently, pronounced its market significance by creating store brands like Ann Page or Archer Farms foods, Family Dollar now sells Family Gourmet packaged meals, and Dollar General promotes its line of discounted packaged foods with the bucolic handle Clover Valley.

What does all this mean for the independent dollar stores? Is there a place for them in the evolving dollar-store economy? There is, but only if they are willing to hustle for pennies.

I called JC Sales, one of the big warehouse suppliers of independent dollar stores located south of Los Angeles, and talked to Wally Lee, director of marketing and technology. He agreed there was little room for error now. If I wanted to open a dollar store, I asked him, where would he suggest I locate it? "Right next to a Wal-Mart or a Target," he said. And how large should my new store be? "If you want to be profitable, start with an 8,000-square-foot store," he said. "That is the most optimally profitable among all our customers." Stores can be as small as 1,000 square feet and go up to 20,000, but Lee implied that there is practically an algorithm of size, labor and expenses — 8,000 to 10,000 square feet is profitability's sweet spot. But it's not all science, Lee said. The very absence of a planogram is the other advantage independents can have.

"You need to have a good store manager who loves to talk to people," Lee said. "If it is a Spanish market, then it has to be a Spanish manager to speak to them to see what their needs are. If you don't do that, you'll never beat anybody else."

In other words, even as the corporate chains standardize their inventory and planogram their stores down to the last Wow shammy, the independents flourish by retaining a Bob Hamilton-like sensibility — the sense that the market is in motion — with managers buzzing about the store, constantly tweaking the inventory, moving stuff around, ordering things that people request, changing the lineup again, trying out a different placement, listening, yakking and hand-trucking more product onto the floor.

In the basement of American capitalism, you can see the invisible hand at work, except it's not invisible. It's actually your hand.

The streamlining of the big dollar stores opens up, for other outlets, their original source of cheap merchandise: distressed goods, closeouts, overstock, salvage merchandize, department-store returns, liquidated goods, discontinued lines, clearance items, ex-catalog stock, freight-damaged goods, irregulars, salvage cosmetics, test-market items and bankruptcy inventories.

This secondary market supplies another stratum of retail chains below the dollar-store channel, one of the best known being Big Lots. Hamilton explained that if these guys don't sell the merchandise, it bumps on down the line to another level known as liquidators.

Hamilton drove me out to Steve's Liquidators outside Portland, Ore. It was marked by only a sign on the road. The store itself was an unadorned massive warehouse, with not even a sign over the door, a Euclidean concrete cube painted a bright lime green with lemon yellow trim.

As we entered, a scruffy man exited, pushing a busted cart — each palsied wheel pulling in a different direction — into a busy parking lot brimming with older-model automobiles. Inside, the store could not have been more spare, a decrepit imitation of a standard suburban grocery store. Exposed warehouse ceilings above, and below, an unfinished shop floor occupied by metal industrial shelving with aisles wide and deep enough to forklift in the goods. Here is where food products minutes away from expiration hover, on the cusp of becoming compost.

A pallet of giant restaurant-grade cans formed a giant ingot of eggplant in tomato sauce. Hamilton examined the cans, each dented and dinged, labels torn — all still sitting on a wooden pallet, partly in its shrink-wrap. "Must have fallen off a truck," he mused. There were sparse fruits and vegetables and rows of salvaged canned goods. Scattered throughout and along the sides were whatever else had been left behind at the dollar stores and then the closeout stores and maybe even the thrift shops — dozens of princess night lights, a single mattress leaning against a wall, a pallet of car oil, an array of carpets, a thousand boxes of the same generic cornflakes, a leaf blower. Back in the car, I asked Hamilton where the merchandise would go if it didn't sell here.

"The Dumpster," he said.

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http://www.nytimes.com/2011/08/21/magazine/the-dollar-store-economy.html?_r=1&ref=magazine

Further, Faster, Higher: Wildlife Responds Increasingly Rapidly to Climate Change

An Atlas moth (Attacus atlas) found in the foothills of Mt Kinabalu in Borneo, with first author I-Ching Chen. (Credit: Image courtesy of University of York)

ScienceDaily (Aug. 19, 2011) — New research by scientists in the Department of Biology at the University of York shows that species have responded to climate change up to three times faster than previously appreciated. These results are published in the latest issue of the leading scientific journal *Science*.

Faster distribution changes. Species have moved towards the poles (further north in the northern hemisphere, to locations where conditions are cooler) at three times the rate previously accepted in the scientific literature, and they have moved to cooler, higher altitudes at twice the rate previously realised.

Analysing data for over 2000 responses by animal and plant species, the research team estimated that, on average, species have moved to higher elevations at 12.2 metres per decade and, more dramatically, to higher latitudes at 17.6 kilometres per decade.

Project leader Chris Thomas, Professor of Conservation Biology at York, said: "These changes are equivalent to animals and plants shifting away from the Equator at around 20 cm per hour, for every hour of the day, for every day of the year. This has been going on for the last 40 years and is set to continue for at least the rest of this century. "

The link to climate change. This study for the first time showed that species have moved furthest in regions where the climate has warmed the most, unambiguously linking the changes in where species survive to climate warming over the last 40 years.

First author Dr I-Ching Chen, previously a PhD student at York and now a researcher at the Academia Sinica in Taiwan, said: "This research shows that it is global warming that is causing species to move towards the poles and to higher elevations. We have for the first time shown that the amount by which the distributions of species have changed is correlated with the amount the climate has changed in that region."

Co-author Dr Ralf Ohlemüller, from Durham University, said: "We were able to calculate how far species might have been expected to move so that the temperatures they experience today are the same as the ones they used to experience, before global warming kicked in. Remarkably, species have on average moved towards the poles as rapidly as expected."

A diversity of changes. These conclusions hold for the average responses of species, but individual species showed much greater variation. Some species have moved much more slowly than expected, others have not moved, and some have even retreated where they are expected to expand. In contrast, other species have raced ahead, perhaps because they are sensitive to a particular component of climate change (rather than to average warming), or because other changes to the environment have also been driving their responses.

Co-author Dr David Roy, from the Centre for Ecology & Hydrology, illustrates this variation among species: "In Britain, the high brown fritillary butterfly might have been expected to expand northwards into Scotland if climate warming was the only thing affecting it, but it has in fact declined because its habitats have been lost. Meanwhile, the comma butterfly has moved 220 kilometres northwards from central England to Edinburgh, in only two decades."

Similar variation has taken place in other animal groups. Cetti's warbler, a small brown bird with a loud voice, moved northwards in Britain by 150 kilometres during the same period when the Cirl bunting retreated southward by 120 kilometres, the latter experiencing a major decline associated with the intensification of agriculture.

How they did the research. The researchers brought together all of the known studies of how species have changed their distributions, and analysed them together in a "meta-analysis." The changes that were studied include species retreating where conditions are getting too hot (at low altitudes and latitudes), species expanding where conditions are no longer too cold (at high altitude and latitudes), and species staying where they are but with numbers declining in hotter parts and increasing in cooler parts of the range.

They considered studies of latitudinal and elevational range shifts from throughout the world, but most of the available data were from Europe and North America.

Birds, mammals, reptiles, insects, spiders, other invertebrates, and plants featured in the evidence. For example, I-Ching Chen and her colleagues discovered that moths had on average moved 67 metres uphill on Mount Kinabalu in Borneo.

Co-author Jane Hill, Professor of Ecology at York, said: "We have taken the published literature and analysed it to detect what the overall pattern of change is, something that is not possible from an individual study. It's a summary of the state of world knowledge about how the ranges of species are responding to climate change. Our analysis shows that rates of response to climate change are two or three times faster than previously realised."

Implications. The current research does not explicitly consider the risks posed to species from climate change, but previous studies suggest that climate change represents a serious extinction risk to at least 10 per cent of the world's species. Professor Thomas says: "Realisation of how fast species are moving because of climate change indicates that many species may indeed be heading rapidly towards extinction, where climatic

conditions are deteriorating. On the other hand, other species are moving to new areas where the climate has become suitable; so there will be some winners as well as many losers."

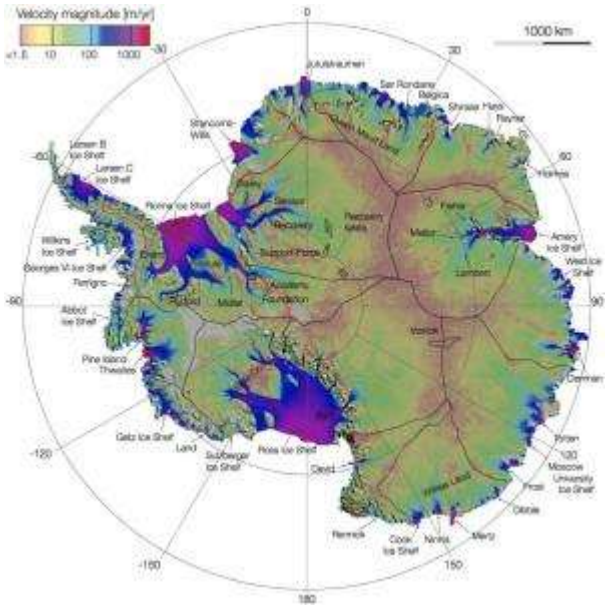
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by University of York.

Journal Reference:

1. I.-C. Chen, J. K. Hill, R. Ohlemuller, D. B. Roy, C. D. Thomas. Rapid Range Shifts of Species Associated with High Levels of Climate Warming. *Science*, 2011; 333 (6045): 1024 DOI: 10.1126/science.1206432

http://www.sciencedaily.com/releases/2011/08/110818142727.htm

Researchers Chart Long-Shrouded Glacial Reaches of Antarctica: Huge Rivers of Ice Are Found Flowing Seaward from Continent's Deep Interior



Antarctica glacial velocity map. (Credit: Image courtesy of University of California - Irvine)

ScienceDaily (Aug. 19, 2011) — A vast network of previously unmapped glaciers on the move from thousands of miles inland to the Antarctic coast has been charted for the first time by UC Irvine scientists. The findings will be critical to tracking future sea rise from climate change.

"This is like seeing a map of all the oceans' currents for the first time. It's a game changer for glaciology," said UCI earth system science professor Eric Rignot, lead author of a paper on the ice flow published online in *Science* Express. "We're seeing amazing flows from the heart of the continent that had never been described before."

Rignot, who is also with NASA's Jet Propulsion Laboratory, and UCI associate project scientists Jeremie Mouginot and Bernd Scheuchl used billions of points of data captured by European, Japanese and Canadian satellites to weed out cloud cover, solar glare and land features. With the aid of NASA technology, they painstakingly pieced together the shape and velocity of glacial formations, including the huge bulk of previously uncharted East Antarctica, which comprises 77 percent of the continent.

Like viewing a completed jigsaw puzzle, Rignot said, the men were stunned when they stood back and took in the full picture. They discovered a new ridge splitting the 5.4 million-square-mile landmass from east to west. They found unnamed formations moving up to 800 feet each year across immense plains sloping toward the Southern Ocean -- and in a different manner than past models of ice migration.

"These researchers created something deceptively simple: a map of the speed and direction of ice in Antarctica," said Thomas Wagner, a cryospheric program scientist with NASA's MEaSUREs program, which funded the work. "But they used it to figure out something fundamentally new: that ice moves by slipping at its bed, not just at the coast but all the way to the deep interior of Antarctica."

"That's critical knowledge for predicting future sea-level rise," he added. "It means that if we lose ice at the coasts from the warming ocean, we open the tap to the ice in the interior."

The work was completed during a period called the International Polar Year, and is the first such study since 1957. Collaborators working under the aegis of the Space Task Group were NASA, European Space Agency, Canadian Space Agency, Japanese Aerospace Exploration Agency, as well as the Alaska Satellite Facility, and MacDonald, Dettwiler & Associates Ltd.

"To our knowledge, this is the first time that a tightly knit collaboration of civilian space agencies has worked together to create such a huge dataset of this type," said Yves Crevier of the Canadian Space Agency. "It is a dataset of lasting scientific value in assessing the extent and rate of change in polar regions."

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

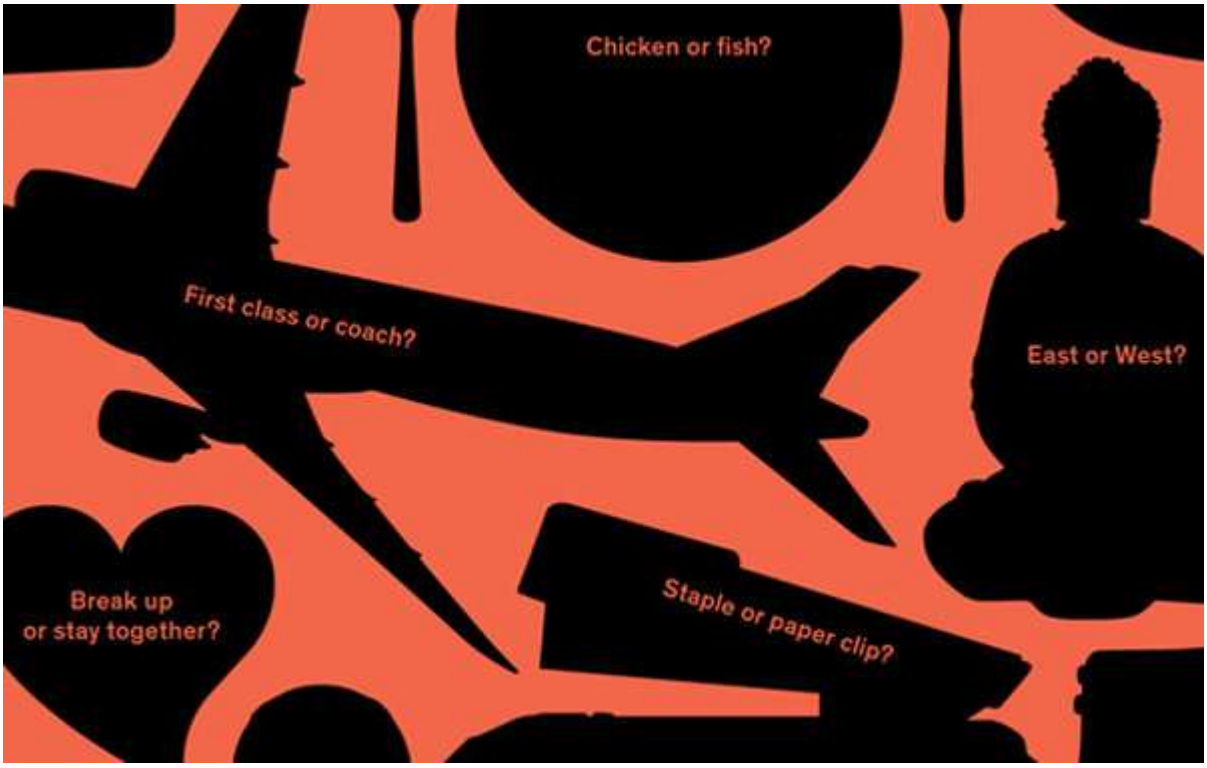
Journal Reference:

1. E. Rignot, J. Mouginot, B. Scheuchl. Ice Flow of the Antarctic Ice Sheet. *Science*, 2011; DOI: 10.1126/science.1208336

http://www.sciencedaily.com/releases/2011/08/110818142741.htm

Do You Suffer From Decision Fatigue?

By JOHN TIERNEY



By JOHN TIERNEY

Three men doing time in Israeli prisons recently appeared before a parole board consisting of a judge, a criminologist and a social worker. The three prisoners had completed at least two-thirds of their sentences, but the parole board granted freedom to only one of them. Guess which one:

Case 1 (heard at 8:50 a.m.): An Arab Israeli serving a 30-month sentence for fraud.

Case 2 (heard at 3:10 p.m.): A Jewish Israeli serving a 16-month sentence for assault.

Case 3 (heard at 4:25 p.m.): An Arab Israeli serving a 30-month sentence for fraud.

There was a pattern to the parole board's decisions, but it wasn't related to the men's ethnic backgrounds, crimes or sentences. It was all about timing, as researchers discovered by analyzing more than 1,100 decisions over the course of a year. Judges, who would hear the prisoners' appeals and then get advice from the other members of the board, approved parole in about a third of the cases, but the probability of being paroled fluctuated wildly throughout the day. Prisoners who appeared early in the morning received parole about 70 percent of the time, while those who appeared late in the day were paroled less than 10 percent of the time.

The odds favored the prisoner who appeared at 8:50 a.m. — and he did in fact receive parole. But even though the other Arab Israeli prisoner was serving the same sentence for the same crime — fraud — the odds were against him when he appeared (on a different day) at 4:25 in the afternoon. He was denied parole, as was

the Jewish Israeli prisoner at 3:10 p.m, whose sentence was shorter than that of the man who was released. They were just asking for parole at the wrong time of day.

There was nothing malicious or even unusual about the judges' behavior, which was reported earlier this year by Jonathan Levav of Stanford and Shai Danziger of Ben-Gurion University. The judges' erratic judgment was due to the occupational hazard of being, as George W. Bush once put it, "the decider." The mental work of ruling on case after case, whatever the individual merits, wore them down. This sort of decision fatigue can make quarterbacks prone to dubious choices late in the game and C.F.O.'s prone to disastrous dalliances late in the evening. It routinely warps the judgment of everyone, executive and nonexecutive, rich and poor — in fact, it can take a special toll on the poor. Yet few people are even aware of it, and researchers are only beginning to understand why it happens and how to counteract it.

Decision fatigue helps explain why ordinarily sensible people get angry at colleagues and families, splurge on clothes, buy junk food at the supermarket and can't resist the dealer's offer to rustproof their new car. No matter how rational and high-minded you try to be, you can't make decision after decision without paying a biological price. It's different from ordinary physical fatigue — you're not consciously aware of being tired — but you're low on mental energy. The more choices you make throughout the day, the harder each one becomes for your brain, and eventually it looks for shortcuts, usually in either of two very different ways. One shortcut is to become reckless: to act impulsively instead of expending the energy to first think through the consequences. (Sure, tweet that photo! What could go wrong?) The other shortcut is the ultimate energy saver: do nothing. Instead of agonizing over decisions, avoid any choice. Ducking a decision often creates bigger problems in the long run, but for the moment, it eases the mental strain. You start to resist any change, any potentially risky move — like releasing a prisoner who might commit a crime. So the fatigued judge on a parole board takes the easy way out, and the prisoner keeps doing time.

Decision fatigue is the newest discovery involving a phenomenon called ego depletion, a term coined by the social psychologist Roy F. Baumeister in homage to a Freudian hypothesis. Freud speculated that the self, or ego, depended on mental activities involving the transfer of energy. He was vague about the details, though, and quite wrong about some of them (like his idea that artists "sublimate" sexual energy into their work, which would imply that adultery should be especially rare at artists' colonies). Freud's energy model of the self was generally ignored until the end of the century, when Baumeister began studying mental discipline in a series of experiments, first at Case Western and then at Florida State University.

These experiments demonstrated that there is a finite store of mental energy for exerting self-control. When people fended off the temptation to scarf down M&M's or freshly baked chocolate-chip cookies, they were then less able to resist other temptations. When they forced themselves to remain stoic during a tearjerker movie, afterward they gave up more quickly on lab tasks requiring self-discipline, like working on a geometry puzzle or squeezing a hand-grip exerciser. Willpower turned out to be more than a folk concept or a metaphor. It really was a form of mental energy that could be exhausted. The experiments confirmed the 19th-century notion of willpower being like a muscle that was fatigued with use, a force that could be conserved by avoiding temptation. To study the process of ego depletion, researchers concentrated initially on acts involving self-control — the kind of self-discipline popularly associated with willpower, like resisting a bowl of ice cream. They weren't concerned with routine decision-making, like choosing between chocolate and vanilla, a mental process that they assumed was quite distinct and much less strenuous. Intuitively, the chocolate-vanilla choice didn't appear to require willpower.

But then a postdoctoral fellow, Jean Twenge, started working at Baumeister's laboratory right after planning her wedding. As Twenge studied the results of the lab's ego-depletion experiments, she remembered how exhausted she felt the evening she and her fiancé went through the ritual of registering for gifts. Did they want plain white china or something with a pattern? Which brand of knives? How many towels? What kind of sheets? Precisely how many threads per square inch?

"By the end, you could have talked me into anything," Twenge told her new colleagues. The symptoms sounded familiar to them too, and gave them an idea. A nearby department store was holding a going-out-of-business sale, so researchers from the lab went off to fill their car trunks with simple products — not exactly wedding-quality gifts, but sufficiently appealing to interest college students. When they came to the lab, the students were told they would get to keep one item at the end of the experiment, but first they had to make a series of choices. Would they prefer a pen or a candle? A vanilla-scented candle or an almond-scented one? A candle or a T-shirt? A black T-shirt or a red T-shirt? A control group, meanwhile — let's call them the nondeciders — spent an equally long period contemplating all these same products without having to make any choices. They were asked just to give their opinion of each product and report how often they had used such a product in the last six months.

Afterward, all the participants were given one of the classic tests of self-control: holding your hand in ice water for as long as you can. The impulse is to pull your hand out, so self-discipline is needed to keep the hand underwater. The deciders gave up much faster; they lasted 28 seconds, less than half the 67-second average of the nondeciders. Making all those choices had apparently sapped their willpower, and it wasn't an isolated effect. It was confirmed in other experiments testing students after they went through exercises like choosing courses from the college catalog.

For a real-world test of their theory, the lab's researchers went into that great modern arena of decision making: the suburban mall. They interviewed shoppers about their experiences in the stores that day and then asked them to solve some simple arithmetic problems. The researchers politely asked them to do as many as possible but said they could quit at any time. Sure enough, the shoppers who had already made the most decisions in the stores gave up the quickest on the math problems. When you shop till you drop, your willpower drops, too.

Any decision, whether it's what pants to buy or whether to start a war, can be broken down into what psychologists call the Rubicon model of action phases, in honor of the river that separated Italy from the Roman province of Gaul. When Caesar reached it in 49 B.C., on his way home after conquering the Gauls, he knew that a general returning to Rome was forbidden to take his legions across the river with him, lest it be considered an invasion of Rome. Waiting on the Gaul side of the river, he was in the "predecisional phase" as he contemplated the risks and benefits of starting a civil war. Then he stopped calculating and crossed the Rubicon, reaching the "postdecisional phase," which Caesar defined much more felicitously: "The die is cast."

The whole process could deplete anyone's willpower, but which phase of the decision-making process was most fatiguing? To find out, Kathleen Vohs, a former colleague of Baumeister's now at the University of Minnesota, performed an experiment using the self-service Web site of Dell Computers. One group in the experiment carefully studied the advantages and disadvantages of various features available for a computer — the type of screen, the size of the hard drive, etc. — without actually making a final decision on which ones to choose. A second group was given a list of predetermined specifications and told to configure a computer by going through the laborious, step-by-step process of locating the specified features among the arrays of options and then clicking on the right ones. The purpose of this was to duplicate everything that happens in the postdecisional phase, when the choice is implemented. The third group had to figure out for themselves which features they wanted on their computers and go through the process of choosing them; they didn't simply ponder options (like the first group) or implement others' choices (like the second group). They had to cast the die, and that turned out to be the most fatiguing task of all. When self-control was measured, they were the one who were most depleted, by far.

The experiment showed that crossing the Rubicon is more tiring than anything that happens on either bank — more mentally fatiguing than sitting on the Gaul side contemplating your options or marching on Rome once you've crossed. As a result, someone without Caesar's willpower is liable to stay put. To a fatigued judge, denying parole seems like the easier call not only because it preserves the status quo and eliminates the risk of

a parolee going on a crime spree but also because it leaves more options open: the judge retains the option of paroling the prisoner at a future date without sacrificing the option of keeping him securely in prison right now. Part of the resistance against making decisions comes from our fear of giving up options. The word "decide" shares an etymological root with "homicide," the Latin word "caedere," meaning "to cut down" or "to kill," and that loss looms especially large when decision fatigue sets in.

Once you're mentally depleted, you become reluctant to make trade-offs, which involve a particularly advanced and taxing form of decision making. In the rest of the animal kingdom, there aren't a lot of protracted negotiations between predators and prey. To compromise is a complex human ability and therefore one of the first to decline when willpower is depleted. You become what researchers call a cognitive miser, hoarding your energy. If you're shopping, you're liable to look at only one dimension, like price: just give me the cheapest. Or you indulge yourself by looking at quality: I want the very best (an especially easy strategy if someone else is paying). Decision fatigue leaves you vulnerable to marketers who know how to time their sales, as Jonathan Levav, the Stanford professor, demonstrated in experiments involving tailored suits and new cars.

The idea for these experiments also happened to come in the preparations for a wedding, a ritual that seems to be the decision-fatigue equivalent of Hell Week. At his fiancée's suggestion, Levav visited a tailor to have a bespoke suit made and began going through the choices of fabric, type of lining and style of buttons, lapels, cuffs and so forth.

"By the time I got through the third pile of fabric swatches, I wanted to kill myself," Levav recalls. "I couldn't tell the choices apart anymore. After a while my only response to the tailor became 'What do you recommend?' I just couldn't take it."

Levav ended up not buying any kind of bespoke suit (the $2,000 price made that decision easy enough), but he put the experience to use in a pair of experiments conducted with Mark Heitmann, then at Christian-Albrechts University in Germany; Andreas Herrmann, at the University of St. Gallen in Switzerland; and Sheena Iyengar, of Columbia. One involved asking M.B.A. students in Switzerland to choose a bespoke suit; the other was conducted at German car dealerships, where customers ordered options for their new sedans. The car buyers — and these were real customers spending their own money — had to choose, for instance, among 4 styles of gearshift knobs, 13 kinds of wheel rims, 25 configurations of the engine and gearbox and a palette of 56 colors for the interior.

As they started picking features, customers would carefully weigh the choices, but as decision fatigue set in, they would start settling for whatever the default option was. And the more tough choices they encountered early in the process — like going through those 56 colors to choose the precise shade of gray or brown — the quicker people became fatigued and settled for the path of least resistance by taking the default option. By manipulating the order of the car buyers' choices, the researchers found that the customers would end up settling for different kinds of options, and the average difference totaled more than 1,500 euros per car (about $2,000 at the time). Whether the customers paid a little extra for fancy wheel rims or a lot extra for a more powerful engine depended on when the choice was offered and how much willpower was left in the customer.

Similar results were found in the experiment with custom-made suits: once decision fatigue set in, people tended to settle for the recommended option. When they were confronted early on with the toughest decisions — the ones with the most options, like the 100 fabrics for the suit — they became fatigued more quickly and also reported enjoying the shopping experience less.

Shopping can be especially tiring for the poor, who have to struggle continually with trade-offs. Most of us in America won't spend a lot of time agonizing over whether we can afford to buy soap, but it can be a depleting choice in rural India. Dean Spears, an economist at Princeton, offered people in 20 villages in Rajasthan in northwestern India the chance to buy a couple of bars of brand-name soap for the equivalent of less than 20

cents. It was a steep discount off the regular price, yet even that sum was a strain for the people in the 10 poorest villages. Whether or not they bought the soap, the act of making the decision left them with less willpower, as measured afterward in a test of how long they could squeeze a hand grip. In the slightly more affluent villages, people's willpower wasn't affected significantly. Because they had more money, they didn't have to spend as much effort weighing the merits of the soap versus, say, food or medicine.

Spears and other researchers argue that this sort of decision fatigue is a major — and hitherto ignored — factor in trapping people in poverty. Because their financial situation forces them to make so many trade-offs, they have less willpower to devote to school, work and other activities that might get them into the middle class. It's hard to know exactly how important this factor is, but there's no doubt that willpower is a special problem for poor people. Study after study has shown that low self-control correlates with low income as well as with a host of other problems, including poor achievement in school, divorce, crime, alcoholism and poor health. Lapses in self-control have led to the notion of the "undeserving poor" — epitomized by the image of the welfare mom using food stamps to buy junk food — but Spears urges sympathy for someone who makes decisions all day on a tight budget. In one study, he found that when the poor and the rich go shopping, the poor are much more likely to eat during the shopping trip. This might seem like confirmation of their weak character — after all, they could presumably save money and improve their nutrition by eating meals at home instead of buying ready-to-eat snacks like Cinnabons, which contribute to the higher rate of obesity among the poor. But if a trip to the supermarket induces more decision fatigue in the poor than in the rich — because each purchase requires more mental trade-offs — by the time they reach the cash register, they'll have less willpower left to resist the Mars bars and Skittles. Not for nothing are these items called impulse purchases.

And this isn't the only reason that sweet snacks are featured prominently at the cash register, just when shoppers are depleted after all their decisions in the aisles. With their willpower reduced, they're more likely to yield to any kind of temptation, but they're especially vulnerable to candy and soda and anything else offering a quick hit of sugar. While supermarkets figured this out a long time ago, only recently did researchers discover why.

The discovery was an accident resulting from a failed experiment at Baumeister's lab. The researchers set out to test something called the Mardi Gras theory — the notion that you could build up willpower by first indulging yourself in pleasure, the way Mardi Gras feasters do just before the rigors of Lent. In place of a Fat Tuesday breakfast, the chefs in the lab at Florida State whipped up lusciously thick milkshakes for a group of subjects who were resting in between two laboratory tasks requiring willpower. Sure enough, the delicious shakes seemed to strengthen willpower by helping people perform better than expected on the next task. So far, so good. But the experiment also included a control group of people who were fed a tasteless concoction of low-fat dairy glop. It provided them with no pleasure, yet it produced similar improvements in self-control. The Mardi Gras theory looked wrong. Besides tragically removing an excuse for romping down the streets of New Orleans, the result was embarrassing for the researchers. Matthew Gailliot, the graduate student who ran the study, stood looking down at his shoes as he told Baumeister about the fiasco.

Baumeister tried to be optimistic. Maybe the study wasn't a failure. Something had happened, after all. Even the tasteless glop had done the job, but how? If it wasn't the pleasure, could it be the calories? At first the idea seemed a bit daft. For decades, psychologists had been studying performance on mental tasks without worrying much about the results being affected by dairy-product consumption. They liked to envision the human mind as a computer, focusing on the way it processed information. In their eagerness to chart the human equivalent of the computer's chips and circuits, most psychologists neglected one mundane but essential part of the machine: the power supply. The brain, like the rest of the body, derived energy from glucose, the simple sugar manufactured from all kinds of foods. To establish cause and effect, researchers at Baumeister's lab tried refueling the brain in a series of experiments involving lemonade mixed either with sugar or with a diet sweetener. The sugary lemonade provided a burst of glucose, the effects of which could be observed right away in the lab; the sugarless variety tasted quite similar without providing the same burst of glucose. Again and again, the sugar restored willpower, but the artificial sweetener had no effect. The

glucose would at least mitigate the ego depletion and sometimes completely reverse it. The restored willpower improved people's self-control as well as the quality of their decisions: they resisted irrational bias when making choices, and when asked to make financial decisions, they were more likely to choose the better long-term strategy instead of going for a quick payoff. The ego-depletion effect was even demonstrated with dogs in two studies by Holly Miller and Nathan DeWall at the University of Kentucky. After obeying sit and stay commands for 10 minutes, the dogs performed worse on self-control tests and were also more likely to make the dangerous decision to challenge another dog's turf. But a dose of glucose restored their willpower.

Despite this series of findings, brain researchers still had some reservations about the glucose connection. Skeptics pointed out that the brain's overall use of energy remains about the same regardless of what a person is doing, which doesn't square easily with the notion of depleted energy affecting willpower. Among the skeptics was Todd Heatherton, who worked with Baumeister early in his career and eventually wound up at Dartmouth, where he became a pioneer of what is called social neuroscience: the study of links between brain processes and social behavior. He believed in ego depletion, but he didn't see how this neural process could be caused simply by variations in glucose levels. To observe the process — and to see if it could be reversed by glucose — he and his colleagues recruited 45 female dieters and recorded images of their brains as they reacted to pictures of food. Next the dieters watched a comedy video while forcing themselves to suppress their laughter — a standard if cruel way to drain mental energy and induce ego depletion. Then they were again shown pictures of food, and the new round of brain scans revealed the effects of ego depletion: more activity in the nucleus accumbens, the brain's reward center, and a corresponding decrease in the amygdala, which ordinarily helps control impulses. The food's appeal registered more strongly while impulse control weakened — not a good combination for anyone on a diet. But suppose people in this ego-depleted state got a quick dose of glucose? What would a scan of their brains reveal?

The results of the experiment were announced in January, during Heatherton's speech accepting the leadership of the Society for Personality and Social Psychology, the world's largest group of social psychologists. In his presidential address at the annual meeting in San Antonio, Heatherton reported that administering glucose completely reversed the brain changes wrought by depletion — a finding, he said, that thoroughly surprised him. Heatherton's results did much more than provide additional confirmation that glucose is a vital part of willpower; they helped solve the puzzle over how glucose could work without global changes in the brain's total energy use. Apparently ego depletion causes activity to rise in some parts of the brain and to decline in others. Your brain does not stop working when glucose is low. It stops doing some things and starts doing others. It responds more strongly to immediate rewards and pays less attention to long-term prospects.

The discoveries about glucose help explain why dieting is a uniquely difficult test of self-control — and why even people with phenomenally strong willpower in the rest of their lives can have such a hard time losing weight. They start out the day with virtuous intentions, resisting croissants at breakfast and dessert at lunch, but each act of resistance further lowers their willpower. As their willpower weakens late in the day, they need to replenish it. But to resupply that energy, they need to give the body glucose. They're trapped in a nutritional catch-22:

1. In order not to eat, a dieter needs willpower.

2. In order to have willpower, a dieter needs to eat.

As the body uses up glucose, it looks for a quick way to replenish the fuel, leading to a craving for sugar. After performing a lab task requiring self-control, people tend to eat more candy but not other kinds of snacks, like salty, fatty potato chips. The mere expectation of having to exert self-control makes people hunger for sweets. A similar effect helps explain why many women yearn for chocolate and other sugary treats just before menstruation: their bodies are seeking a quick replacement as glucose levels fluctuate. A sugar-filled snack or drink will provide a quick improvement in self-control (that's why it's convenient to use

in experiments), but it's just a temporary solution. The problem is that what we identify as sugar doesn't help as much over the course of the day as the steadier supply of glucose we would get from eating proteins and other more nutritious foods.

The benefits of glucose were unmistakable in the study of the Israeli parole board. In midmorning, usually a little before 10:30, the parole board would take a break, and the judges would be served a sandwich and a piece of fruit. The prisoners who appeared just before the break had only about a 20 percent chance of getting parole, but the ones appearing right after had around a 65 percent chance. The odds dropped again as the morning wore on, and prisoners really didn't want to appear just before lunch: the chance of getting parole at that time was only 10 percent. After lunch it soared up to 60 percent, but only briefly. Remember that Jewish Israeli prisoner who appeared at 3:10 p.m. and was denied parole from his sentence for assault? He had the misfortune of being the sixth case heard after lunch. But another Jewish Israeli prisoner serving the same sentence for the same crime was lucky enough to appear at 1:27 p.m., the first case after lunch, and he was rewarded with parole. It must have seemed to him like a fine example of the justice system at work, but it probably had more to do with the judge's glucose levels.

It's simple enough to imagine reforms for the parole board in Israel — like, say, restricting each judge's shift to half a day, preferably in the morning, interspersed with frequent breaks for food and rest. But it's not so obvious what to do with the decision fatigue affecting the rest of society. Even if we could all afford to work half-days, we would still end up depleting our willpower all day long, as Baumeister and his colleagues found when they went into the field in Würzburg in central Germany. The psychologists gave preprogrammed BlackBerrys to more than 200 people going about their daily routines for a week. The phones went off at random intervals, prompting the people to report whether they were currently experiencing some sort of desire or had recently felt a desire. The painstaking study, led by Wilhelm Hofmann, then at the University of Würzburg, collected more than 10,000 momentary reports from morning until midnight.

Desire turned out to be the norm, not the exception. Half the people were feeling some desire when their phones went off — to snack, to goof off, to express their true feelings to their bosses — and another quarter said they had felt a desire in the past half-hour. Many of these desires were ones that the men and women were trying to resist, and the more willpower people expended, the more likely they became to yield to the next temptation that came along. When faced with a new desire that produced some I-want-to-but-I-really-shouldn't sort of inner conflict, they gave in more readily if they had already fended off earlier temptations, particularly if the new temptation came soon after a previously reported one.

The results suggested that people spend between three and four hours a day resisting desire. Put another way, if you tapped four or five people at any random moment of the day, one of them would be using willpower to resist a desire. The most commonly resisted desires in the phone study were the urges to eat and sleep, followed by the urge for leisure, like taking a break from work by doing a puzzle or playing a game instead of writing a memo. Sexual urges were next on the list of most-resisted desires, a little ahead of urges for other kinds of interactions, like checking Facebook. To ward off temptation, people reported using various strategies. The most popular was to look for a distraction or to undertake a new activity, although sometimes they tried suppressing it directly or simply toughing their way through it. Their success was decidedly mixed. They were pretty good at avoiding sleep, sex and the urge to spend money, but not so good at resisting the lure of television or the Web or the general temptation to relax instead of work.

We have no way of knowing how much our ancestors exercised self-control in the days before BlackBerrys and social psychologists, but it seems likely that many of them were under less ego-depleting strain. When there were fewer decisions, there was less decision fatigue. Today we feel overwhelmed because there are so many choices. Your body may have dutifully reported to work on time, but your mind can escape at any instant. A typical computer user looks at more than three dozen Web sites a day and gets fatigued by the continual decision making — whether to keep working on a project, check out TMZ, follow a link to

YouTube or buy something on Amazon. You can do enough damage in a 10-minute online shopping spree to wreck your budget for the rest of the year.

The cumulative effect of these temptations and decisions isn't intuitively obvious. Virtually no one has a gut-level sense of just how tiring it is to decide. Big decisions, small decisions, they all add up. Choosing what to have for breakfast, where to go on vacation, whom to hire, how much to spend — these all deplete willpower, and there's no telltale symptom of when that willpower is low. It's not like getting winded or hitting the wall during a marathon. Ego depletion manifests itself not as one feeling but rather as a propensity to experience everything more intensely. When the brain's regulatory powers weaken, frustrations seem more irritating than usual. Impulses to eat, drink, spend and say stupid things feel more powerful (and alcohol causes self-control to decline further). Like those dogs in the experiment, ego-depleted humans become more likely to get into needless fights over turf. In making decisions, they take illogical shortcuts and tend to favor short-term gains and delayed costs. Like the depleted parole judges, they become inclined to take the safer, easier option even when that option hurts someone else.

"Good decision making is not a trait of the person, in the sense that it's always there," Baumeister says. "It's a state that fluctuates." His studies show that people with the best self-control are the ones who structure their lives so as to conserve willpower. They don't schedule endless back-to-back meetings. They avoid temptations like all-you-can-eat buffets, and they establish habits that eliminate the mental effort of making choices. Instead of deciding every morning whether or not to force themselves to exercise, they set up regular appointments to work out with a friend. Instead of counting on willpower to remain robust all day, they conserve it so that it's available for emergencies and important decisions.

"Even the wisest people won't make good choices when they're not rested and their glucose is low," Baumeister points out. That's why the truly wise don't restructure the company at 4 p.m. They don't make major commitments during the cocktail hour. And if a decision must be made late in the day, they know not to do it on an empty stomach. "The best decision makers," Baumeister says, "are the ones who know when *not* to trust themselves."

John Tierney (tierneylab@nytimes.com) is a science columnist for The Times. His essay is adapted from a book he wrote with Roy F. Baumeister, "Willpower: Rediscovering the Greatest Human Strength," which comes out next month.

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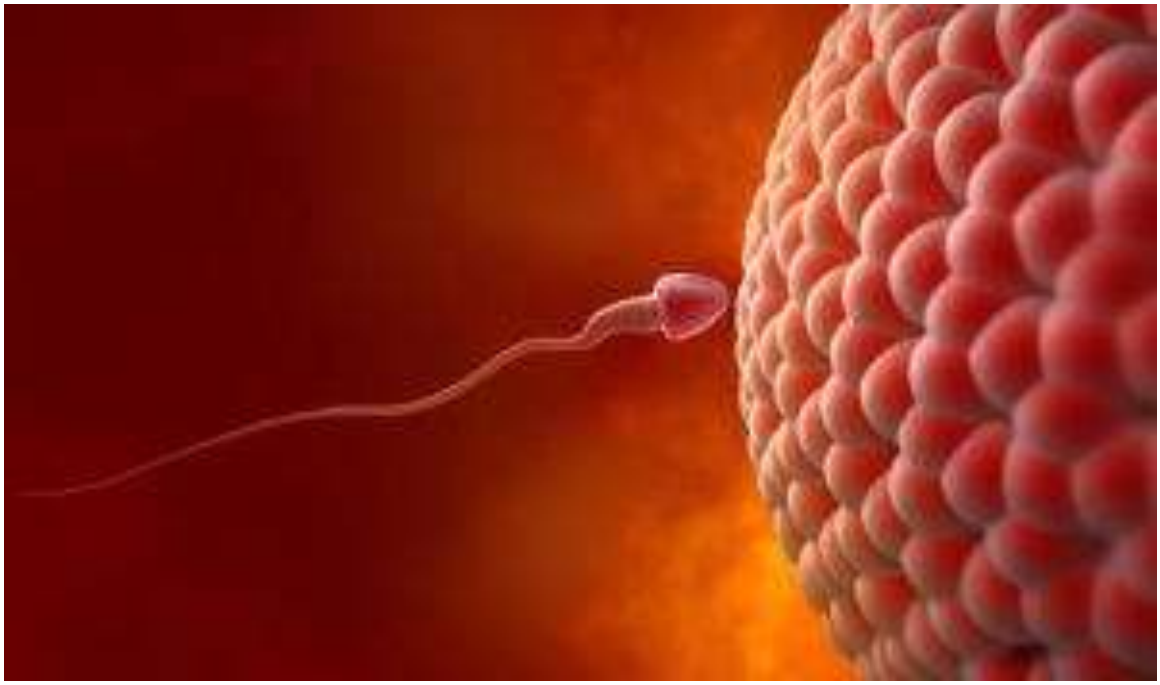
http://www.nytimes.com/2011/08/21/magazine/do-you-suffer-from-decision-fatigue.html?ref=magazine

How Sticky Egg Captures Sperm: Discovery Could Help Explain Infertility Causes and Provide New Contraceptive Targets



Artist's rendering of sperm and egg. (Credit: © Alexandr Mitiuc / Fotolia)

ScienceDaily (Aug. 18, 2011) — Researchers have uncovered exactly how a human egg captures an incoming sperm to begin the fertilisation process, in a new study published this week in the journal *Science*.

The research identifies the sugar molecule that makes the outer coat of the egg 'sticky', which is vital for enabling the sperm and egg to bind together. Researchers across the world have been trying to understand what performs this task for over thirty years.

The scientists behind this study believe their work could help address some of the previously unexplained causes of human infertility and sub-fertility and be very useful for diagnosing this problem in couples who are unable to have children. It could also provide a new target for the development of natural contraceptive agents.

The international team, from the University of Missouri, the University of Hong Kong, Academia Sinica in Taiwan and Imperial College London, discovered that the sugar chain known as the sialyl-lewis-x sequence (SLeX) is highly abundant on the surface of the human egg. After experimenting with a range of synthesised sugars in the laboratory they went on to show that SLeX specifically binds sperm to an egg, and tested their findings using the outer coats of unfertilised 'non-living' human eggs.

"This exciting research is providing the first insights into the molecular events occurring at the very beginning of human life. The details we've discovered here fill in a huge gap in our knowledge of fertility and we hope they will ultimately help many of those people who currently cannot conceive," said Professor Anne Dell CBE FRS FMedSci from the Department of Life Sciences at Imperial College London, who led the team that discovered the SLeX sugars on the egg surface.

"Unravelling the composition of the sugar coat that shrouds the human egg is the culmination of many years of painstaking research by my mass spectrometry colleagues at Imperial. This endeavour was an enormously difficult task because human eggs are very tiny -- about the size of a full stop -- so we didn't have much material to work with."

The World Health Organization estimates that infertility affects up to 15 percent of reproductive-aged couples worldwide and almost one in every seven couples in the UK have problems conceiving a child for various clinical reasons, many of which are still unexplained by medical science.

Lead author, Dr Poh-Choo Pang, also from the Department of Life Sciences at Imperial College London, said: "We hope that our study will open up new possibilities for understanding and addressing the fertility problems that many couples face. Although clinical treatments are still a way off, we are very excited about the new research into fertility that we hope will now be possible, building on our work."

"We first proposed a model of human sperm-binding involving SLeX-like molecules on the outer covering of the human egg in 1992. Our recent studies have now confirmed that this longstanding model is correct," said corresponding author and associate professor Gary Clark, from the University of Missouri School of Medicine. "Defining how the sperm initially recognises and then penetrates the egg's sugar coat is important for the design of natural contraceptive agents and for unravelling causes of previously unexplained human infertility or sub-fertility."

A sperm 'recognises' an egg when proteins on the head of the sperm meet and match a series of specific sugars in the egg's outer coat. Once a successful match has been made, the outside surfaces of the sperm and egg bind together before they merge and the sperm delivers its DNA to the inside, fertilising the egg.

The authors of this new study used ultra-sensitive mass-spectrometric imaging technology to assess which molecules were most likely to be key in the binding process. They discovered that SLeX is abundantly found on the egg's outer coat and that it is expressed at a much higher concentration than any of the other sugars that can be found on the thick transparent shell. From these results, they deduced that SLeX was most likely to be responsible for binding with proteins on the head of the sperm.

The research team in Hong Kong tested whether SLeX was the key binding sugar using the outer coats of unfertilised and non-living human eggs, obtained by informed consent from in vitro-fertilisation patients. They carefully bisected the empty coat in a delicate procedure using a tiny knife, carried out under a powerful microscope. The scientists treated one half with a chemical that prevented the SLeX sugar from binding, to see what effect this would have on a sperm's ability to bind to the egg. When they released sperm around the bisected egg, they found that significantly fewer bound to the treated half of the egg coat than the untreated half.

"Our knowledge on sperm-egg binding in humans is limited. The identification of SLeX would enable researchers to uncover other molecules involved in this important process of human life," said Professor William Yeung from the Department of Obstetrics and Gyneacology and the Centre for Reproduction, Development and Growth at the University of Hong Kong, who led this phase of the research.

The researchers are now keen to use the findings of this study to further investigate the proteins on the head of a sperm that enable it to recognise an egg.

This work was supported in the UK by the Biotechnology and Biological Sciences Research Council (BBSRC) and a Royal Society International Joint Project Award.

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http://www.sciencedaily.com/releases/2011/08/110818142749.htm

Capturing the Idling of the Motor City

By MIKE RUBIN

Andrew Moore
The rolling hall at Ford's River Rouge plant, one of Andrew Moore's photographs of Detroit

RISING nearly 20 stories above the surrounding neighborhood in southwest Detroit, Michigan Central Station is an imposing leviathan of another era. The disembarkation point for countless Motor City migrants seeking a decent wage in Henry Ford's factories, it was Detroit's Ellis Island for the journey toward middle-class life.

Today, however, the Beaux-Arts depot is a forlorn, modern-day Cheops. The last train left the station in 1988, with rail a victim of the city's automotive industry, itself now a shell of its former glory. In a 2008 picture by the New York photographer Andrew Moore, the station's once-opulent waiting room looks as if it had been abandoned eons earlier. Its defaced marble pillars appear ancient, while fallen tiles and debris resemble Moon rocks peeking through a dingy white blanket of snow.

The chilly tableau is the frontispiece of Mr. Moore's 2010 book "Detroit Disassembled" (Damiani/Akron Art Museum) and the initial image in a show of his work at the Queens Museum of Art, which opens next Sunday. Originally exhibited by the Akron Art Museum, the 30 Detroit photos Mr. Moore shot in 2008 and 2009 occupy an entire floor of the Queens Museum. An upstairs gallery features selections from his previous projects documenting the faded splendor of Cuba, post-Soviet Russia and Robert Moses' New York City legacy, to provide context for the Motown work and prove "that I didn't just show up in Detroit and take pictures of decayed buildings," Mr. Moore said with a smile.

Unlike his work in Russia and Havana, Mr. Moore's Detroit photos are largely devoid of people, giving them an eerie, postapocalyptic feel. Evidence charts from a murder investigation are among files strewn across a shuttered police station. Beakers and test tubes line the shelves of a chemistry lab in a former school, waiting for students who will never come. Birch saplings sprout from rotting textbooks at a school book depository. A vacant home is swallowed whole by foliage. Once-bustling neighborhoods dissolve into urban prairie.

"There are hundreds of possible books that can be made about Detroit," Mr. Moore, youthful looking at 54, said in an interview in his compact, book-lined Chelsea studio. "But what I was focused on was the idea that in an urban setting you could also have a landscape happening, the forces of nature intersecting with American urbanism, the process of decline also intersecting with the revival of nature."

Barbara Tannenbaum, the curator of photography at the Cleveland Museum of Art, who organized the "Detroit Disassembled" show while she was at the Akron Art Museum, likened his Detroit photographs to Piranesi's 18th-century prints of Roman ruins and Caspar David Friedrich's 19th-century paintings of crumbling churches. "Artistically they're very important in the way that they combine the almost romantic sense of horror with beauty," she said. "That dissonance between the beauty and the sense of waste and destruction and decay leads you to really consider not just the situation of Detroit but to put them in a larger context of the rise and fall of civilizations, the relationship between human endeavors to build and nature's ability to overwhelm and overcome."

A Connecticut native, Mr. Moore moved to New York in 1980, living near South and John Streets in Lower Manhattan. At night he would wander the neighborhood taking pictures of the construction of the South Street Seaport, which kindled an interest in documenting "life in flux," he said. "I like places in transformation, the process of becoming and changing."

He eventually expanded his vision to places like Bosnia and Vietnam. "I have a perpetual fascination with certain kinds of decayed spaces that have been reappropriated or reused or where the evidence of people struggling to keep their dignity lingers, places that have been abandoned but retain the ghosts of what they were," he said, citing earlier images like a dilapidated Havana opera house that found new life as a bicycle-taxi garage.

It was Detroit's central role in the creation of modern life — "a symbol of our greatness," Mr. Moore said — that initially attracted him to the city as potential subject matter. He spent time there when he worked as the cinematographer and producer of "How To Draw a Bunny," a 2002 documentary about the Detroit-born artist Ray Johnson, but he was unaware of the scope of the area's abandonment: tens of thousands of derelict buildings, from prewar skyscrapers to immense factories to ornate movie palaces. In 2008, however, Mr. Moore was invited by Yves Marchand and Romain Meffre, two young French photographers familiar with his shots of old theaters, to join them on a shooting excursion to Detroit, a destination for the pair since 2005. Inspired by what Mr. Moore called "the spirit of exploration and discovery and trying to get into places that nobody had seen pictures of," the group lugged their large-format cameras around town together.

They were joined by locals like Sean Doerr, a teenager who had explored hundreds of vacant Detroit buildings, while Mr. Moore used his professional contacts to gain access to sites like the original Model T plant, which had been off limits for decades. The group's forays produced three books in the last year: Mr. Moore's "Detroit Disassembled"; "Lost Detroit: Stories Behind the Motor City's Majestic Ruins," which features Mr. Doerr's photographs; and Mr. Marchand and Mr. Meffre's "Ruins of Detroit." This publishing mini-flurry induced a wave of media attention, not all of it positive.

Some people, including many Detroit residents, decried the images as "ruin porn" — urban decay as empty cliché, smacking of voyeurism and exploitation — and critical takedowns ran in The New Republic and the online journal Guernica. The musician Jack White, a Detroit native, told a radio interviewer that the countless photographs of Michigan Central Station were "immortalizing tragedy" and urged people to stop taking them.

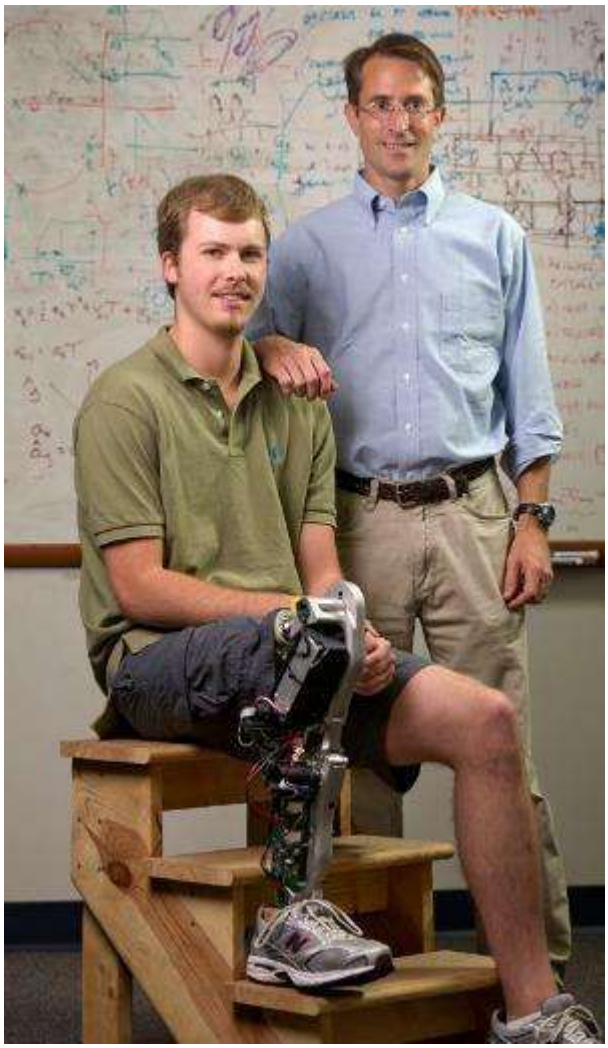
"There's so much more to Detroit than its abandoned buildings," said Jenenne Whitfield, the executive director of the Heidelberg Project, an arts organization there founded by the artist Tyree Guyton, whose sculptural transformation of a block of empty houses draws 275,000 visitors a year. "That's just not who we are."

Although there is plenty of rubble in “Detroit Disassembled,” Mr. Moore’s work usually escapes the narrow constraints of the genre. His large-scale prints—some up to 5 feet by 6 feet — are sumptuous and painterly, rich in texture and color: the emerald carpet of moss growing on the floor of Henry Ford’s office at the Model T plant, the pumpkin-orange walls of a vandalized classroom at Cass Technical High School, the crimson panels of a former F.B.I. shooting range. Photos like those of the enormous rolling hall at Ford’s River Rouge plant and a sunset over the Bob-Lo Island boat dock were inspired, Mr. Moore said, by 19th-century American landscape painters like Frederic Church and Martin Johnson Heade.

Mr. Moore sees the ruin porn controversy as part of the debate about “whether the artist should be socially responsible or work in an unhindered fashion,” he said. “I don’t think those two goals are really reconcilable, but what I do think is that the tension between them, the place where they kind of meet, is a place of great creative traction. And I think Detroit actually is that meeting point, the place where art confronts anxiety.”

http://www.nytimes.com/2011/08/21/arts/design/andrew-moores-photographic-take-on-detroit-decay.html

New 'Bionic' Leg Gives Amputees a Natural Gait



Professor Michael Goldfarb, right, with amputee Craig Hutto who is wearing the new bionic leg developed at Vanderbilt. (Credit: John Russell, Vanderbilt University)

ScienceDaily (Aug. 18, 2011) — A new lower-limb prosthetic developed at Vanderbilt University allows amputees to walk without the leg-dragging gait characteristic of conventional artificial legs.

The device uses the latest advances in computer, sensor, electric motor and battery technology to give it bionic capabilities: It is the first prosthetic with powered knee and ankle joints that operate in unison. It comes equipped with sensors that monitor its user's motion. It has microprocessors programmed to use this data to predict what the person is trying to do and operate the device in ways that facilitate these movements.

A passive leg is always a step behind me. The Vanderbilt leg is only a split-second behind.""When it's working, it's totally different from my current prosthetic," said Craig Hutto, the 23-year-old amputee who has been testing the leg for several years. "A passive leg is always a step behind me. The Vanderbilt leg is only a split-second behind."

The bionic leg is the result of a seven-year research effort at the Vanderbilt Center for Intelligent Mechatronics, directed by Michael Goldfarb, the H. Fort Flowers Professor of Mechanical Engineering. The project was initially funded by a seed grant from the National Science Foundation, followed by a development grant from the National Institutes of Health. Key aspects of the design have been patented by the university, which has granted exclusive rights to develop the prosthesis to Freedom Innovations, a leading developer and manufacturer of lower limb prosthetic devices.

"With our latest model, we have validated our hypothesis that the right technology was available to make a lower-limb prosthetic with powered knee and ankle joints," said Goldfarb. "Our device illustrates the progress we are making at integrating man and machine."

The Vanderbilt prosthesis is designed for daily life. It makes it substantially easier for an amputee to walk, sit, stand, and go up and down stairs and ramps. Studies have shown that users equipped with the device naturally walk 25 percent faster on level surfaces than when they use passive lower-limb prosthetics. That is because it takes users 30 to 40 percent less of their own energy to operate.

"Going up and down slopes is one of the hardest things to do with a conventional leg," said Hutto. "So I have to be conscious of where I go because I can get very tired walking up and down slopes. But that won't be a problem with the powered leg because it goes up and down slopes almost like a natural leg."

Recent technological advances have allowed the Vanderbilt engineers to produce a device that weighs about nine pounds -- less than most human lower legs -- and can operate for three days of normal activity, or 13 to 14 kilometers of continuous walking, on a single charge. They have also dramatically reduced the amount of noise that the latest model makes, although it is slightly louder than they would like.

One of the latest capabilities that the engineers have added is an anti-stumble routine. If the leg senses that its user is starting to stumble, it will lift up the leg to clear any obstruction and plant the foot on the floor.

In order to incorporate all the improvements, the prosthetic's hardware design has gone through seven versions and its electronics board has been redone 15 times.

According to Goldfarb, it was tough to make the prosthetic light and quiet enough. In particular, it was difficult to fit the powerful motors and drive train that they needed into the volume available. The biggest technical challenge, however, was to develop the control system.

"As you add greater capability, you are also adding greater liability," he said. "Not only does the controller have to perform individual operations reliability, but it has to perform several operations at the same time and not get confused."

The Center for Intelligent Mechatronics is also developing an anthropomorphic prosthetic arm project and an advanced exoskeleton to aid in physical therapy.

Story Source:
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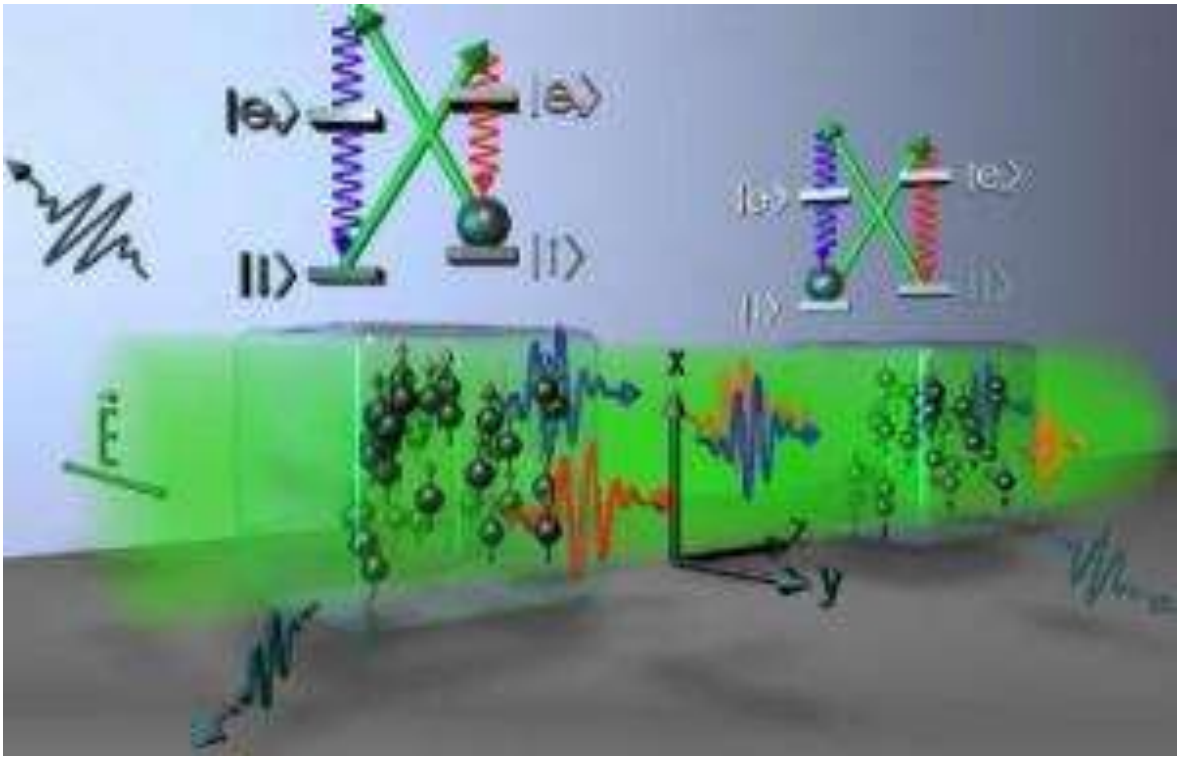
Quantum Optical Link Sets New Time Records



The image shows the two clouds of caesium atoms. The atoms have been entangled using laser light. The atoms spontaneously emit photons in all directions. By designing the experiment in a very precise way the NBI team succeeded in maintaining the entanglement for up to an hour. (Credit: Christine Muschik)

ScienceDaily (Aug. 19, 2011) — Quantum communication could be an option for the absolutely secure transfer of data. The key component in quantum communication over long distances is the special phenomenon called entanglement between two atomic systems. Entanglement between two atomic systems is very fragile and up until now researchers have only been able to maintain the entanglement for a fraction of a second. But in new experiments at the Niels Bohr Institute researchers have succeeded in setting new records and maintaining the entanglement for up to an hour.

The results are published in the scientific journal *Physical Review Letters*.

Entanglement is a curious phenomenon in quantum mechanics which Albert Einstein called "spukhafte Fernwirkung" (spooky action at a distance). Two separate entangled systems have a ghostlike connection even when they are placed at a large distance without being directly connected to each other. It is said that their states are correlated. This means that if you read out the one system, the other system will 'know' about it. In the experiments at the Niels Bohr Institute, the spins of two gas clouds of caesium atoms are entangled.

Control of a spontaneous process

To create the entangled state of the two atomic clouds the researchers use light. Light consists of photons, which are the smallest parts (a quantum) of a light pulse. When you shine a laser beam on atoms the photons are absorbed and subsequently re-emitted spontaneously. This process has been an impediment to the experiments because it is uncontrolled.

"Now we have managed to control this 'spontaneous' process and use it," explains Eugene Polzik, Professor and Director of the Danish National Research Foundation Center, Quantop at the Niels Bohr Institute at the University of Copenhagen.

Maintaining entanglement

In the Quantop laboratories the research group conducted experiments with entanglement using two clouds of caesium atoms placed in separate glass containers. By illuminating both clouds of atoms with laser light, the collective spins of the atoms are manipulated. The two atomic clouds become entangled, which means that some of their properties are correlated.

But the atoms emit photons in all directions and this causes the entanglement to disappear. This usually happens in a fraction of a second.

"What we have done is that we have developed a technique where we renew the entanglement as fast as it disappears. In this way we have been able to maintain the entanglement between the two atomic clouds as long as the experiment lasted, that is to say up to an hour," explains Hanna Krauter, who is a quantum physicist and researcher at Quantop at the Niels Bohr Institute.

From theory to reality

The research has been conducted in collaboration with the Max Planck Institute of Quantum Optics in Germany, where they have been working with the theoretical models. Theoretical physicists have suggested similar techniques for about five years, but it is only now that the NBI team has succeeded in conducting the physical experiments based on these methods and getting them to work.

"The breakthrough has great potential and provides, among other things, a new approach to quantum communication. It is a step towards getting quantum communication to function in practice -- not just in the laboratory, but also in the real world of networking á la the Internet. In addition, it means an improvement of ultra-precise measurements of miniscule magnetic fields with atomic magnetometers. Sensitive magnetometers could be used to measure electrical activity in the human brain and heart," explains Professor Eugene Polzik.

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

Journal Reference:

1. Hanna Krauter, Christine A. Muschik, Kasper Jensen, Wojciech Wasilewski, Jonas M. Petersen, J. Ignacio Cirac, and Eugene S. Polzik. Entanglement Generated by Dissipation and Steady State Entanglement of Two Macroscopic Objects. *Physical Review Letters*, Volume 107, Issue 8 DOI: 10.1103/PhysRevLett.107.080503

http://www.sciencedaily.com/releases/2011/08/110817094920.htm

Nitrogen in the Soil Cleans the Air

What is the source of nitrous acid in the atmosphere? Mainz scientists study the exchange of gases between soil samples and the air in this reaction chamber. (Credit: © Su, Max Planck Institute for Chemistry.)

ScienceDaily (Aug. 19, 2011) — Eutrophication harms the environment in many ways. Unexpectedly, nitrogen fertilizer may also be positive for the environment. And even acidic soils, promoting the destruction of forests, can have a positive effect. Researchers from the Biogeochemistry Department at the Max Planck Institute for Chemistry in Mainz found out that nitrogen fertilizer indirectly strengthens the self-cleaning capacity of the atmosphere.

The new study shows that nitrous acid is formed in fertilized soil and released to the atmosphere, whereby the amount increases with increasing soil acidity. In the air, nitrous acid leads to the formation of hydroxyl radicals oxidizing pollutants that then can be washed out. Previously, this nitrogen-effect has not been taken into account by geoscientists. The gap has now been closed by the Max Planck researchers.

Our air partly cleans itself as pollutants are being oxidized by hydroxyl radicals and washed out by rain. Now, researchers at the Max Planck Institute in Mainz and colleagues in Beijing have discovered the origin of a bulk part of the nitrous acid that is acting beside ozone as a source of hydroxyl radicals. According to their studies, large quantities of the acid are released into the atmosphere from soil. In nitrogen-rich soils the acid is formed from nitrite ions produced through microbiological transformations of ammonium and nitrate ions. The more acidic the soil is and the more nitrite it contains, the more nitrous acid is released. Through this pathway some of the nitrogen in fertilized soil escapes into the air.

In the latest issue of the journal *Science*, the Mainz researchers describe how they demonstrated the existence of this previously unnoticed pathway in the nitrogen cycle. They measured the concentration of HONO -- a chemical term for gaseous nitrous acid -- that escaped from a defined volume of arable soil. They added nitrite to a soil sample and varied its water content. The quantity of released HONO closely matched the researchers' estimates based on acid/base and solubility equilibria. Based on these findings they can also explain why previous studies had measured high levels of HONO in the air above fertilized agricultural soil.

The source of the high concentrations of HONO observed in the lower atmosphere had long been a mystery. "Soil is a complex system involving interactions between countless chemicals and biological organisms," says Hang Su, the lead author of the paper. "Before us, no one seems to have investigated the soil-atmosphere exchange of nitrous acid."

The fact that soil emits HONO is not just locally, but also globally significant for air quality and the nitrogen cycle. "Next, we plan to work across disciplines with soil and climate researchers to quantify the effect in different types of soil and under different environmental conditions," adds research group leader Ulrich Pöschl. The findings will then be incorporated into a global model.

The Max Planck researchers suspect that soil-based HONO emissions could strongly increase especially in developing countries due to more extensive fertilization, soil acidification, and climate-related rise in temperature. This is expected to produce more hydroxyl radicals, which increase the oxidizing power of the air.

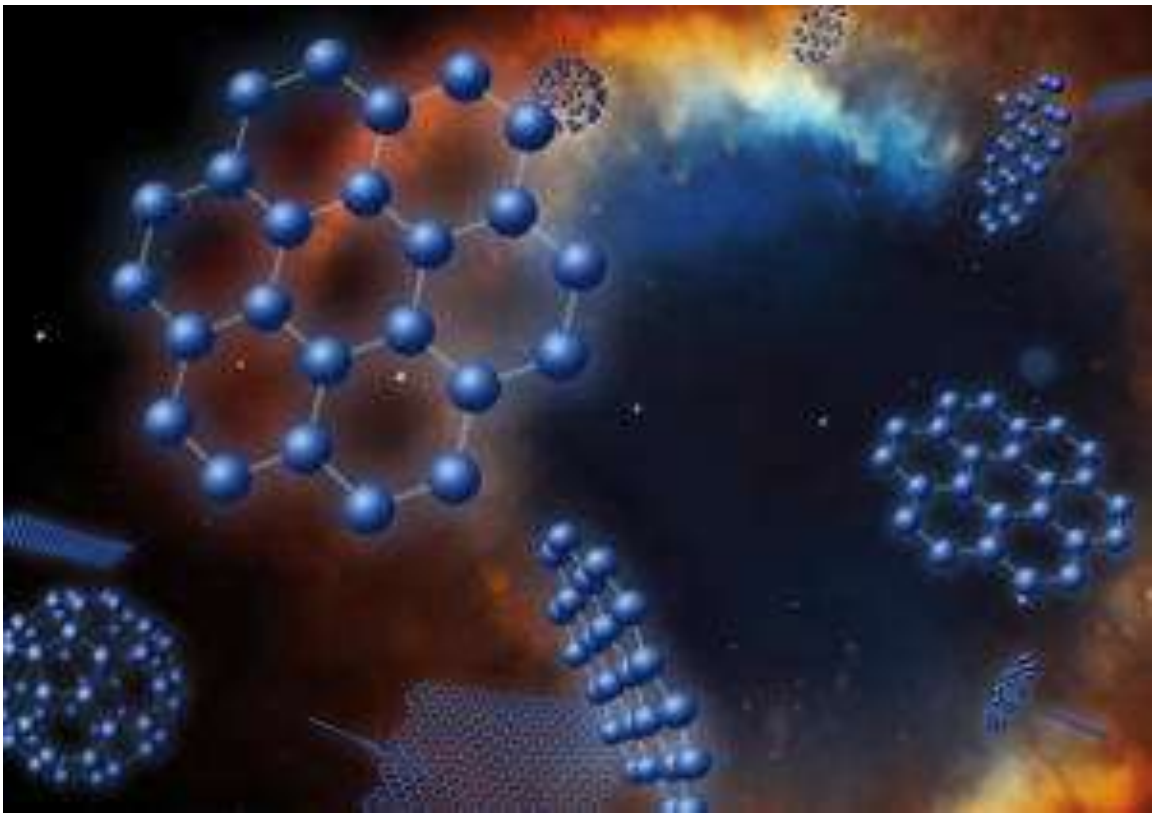
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by Max-Planck-Gesellschaft.

Journal Reference:

1. H. Su, Y. Cheng, R. Oswald, T. Behrendt, I. Trebs, F. X. Meixner, M. O. Andreae, P. Cheng, Y. Zhang, U. Poschl. Soil Nitrite as a Source of Atmospheric HONO and OH Radicals. *Science*, 2011; DOI: 10.1126/science.1207687

http://www.sciencedaily.com/releases/2011/08/110819131519.htm

Honeycomb Carbon Crystals Possibly Detected in Space



An artist's concept of graphene, buckyballs and C70 superimposed on an image of the Helix planetary nebula, a puffed-out cloud of material expelled by a dying star. Image credit: (Credit: IAC/NASA/NOAO/ESA/STScI/NRAO)

ScienceDaily (Aug. 18, 2011) — NASA's Spitzer Space Telescope has spotted the signature of flat carbon flakes, called graphene, in space. If confirmed, this would be the first-ever cosmic detection of the material -- which is arranged like chicken wire in flat sheets that are one atom thick.

Graphene was first synthesized in a lab in 2004, and subsequent research on its unique properties garnered the Nobel Prize in 2010. It's as strong as it is thin, and conducts electricity as well as copper. Some think it's the "material of the future," with applications in computers, screens on electrical devices, solar panels and more.

Graphene in space isn't going to result in any super-fast computers, but researchers are interested in learning more about how it is created. Understanding chemical reactions involving carbon in space may hold clues to how our own carbon-based selves and other life on Earth developed.

Spitzer identified signs of the graphene in two small galaxies outside of our own, called the Magellanic Clouds, specifically in the material shed by dying stars, called planetary nebulae. The infrared-sensing telescope also spotted a related molecule, called C70, in the same region -- marking the first detection of this chemical outside our galaxy.

C70 and graphene belong to the fullerene family, which includes molecules called "buckyballs," or C60. These carbon spheres contain 60 carbon atoms arranged like a soccer ball, and were named after their

resemblance to the architectural domes of Buckminister Fuller. C70 molecules contain 70 carbon atoms and are longer in shape, more like a rugby ball.

Fullerenes have been found in meteorites carrying extraterrestrial gases, and water has been very recently encapsulated in buckyballs by using new laboratory techniques. These findings suggest fullerenes may have helped transport materials from space to Earth long ago, possibly helping to kick-start life.

Spitzer definitively detected both buckyballs and C70 in space for the first time in July 2010. It later spotted buckyballs -- equivalent in mass to 15 full moons -- in the Small Magellanic Cloud. These latter results demonstrated that, contrary to what was previously believed, fullerenes and other complex molecules could form in hydrogen-rich environments.

According to astronomers, the graphene, buckyballs and C70 might be forming when shock waves generated by dying stars break apart hydrogen-containing carbon grains.

The team that performed the Spitzer research is led by Domingo Aníbal García-Hernández of the Instituto de Astrofísica de Canarias in Spain. The results appear in the *Astrophysical Journal Letters*. García-Hernández is also the lead author of the study that used Spitzer to detect heaps of buckyballs in the Small Magellanic Cloud.

NASA's Jet Propulsion Laboratory, Pasadena, Calif., manages the Spitzer Space Telescope mission for NASA's Science Mission Directorate, Washington. Science operations are conducted at the Spitzer Science Center at the California Institute of Technology in Pasadena. Caltech manages JPL for NASA. For more information about Spitzer, visit http://spitzer.caltech.edu/ and http://www.nasa.gov/spitzer .

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

Journal Reference:

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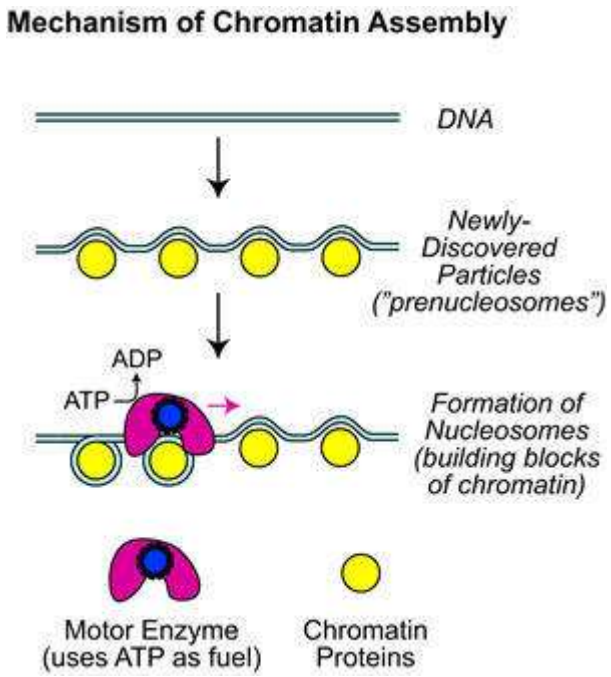
http://www.sciencedaily.com/releases/2011/08/110817121453.htm

Biologists' Discovery May Force Revision of Biology Textbooks: Novel Chromatin Particle Halfway Between DNA and a Nucleosome



Biologists have discovered a novel chromatin particle halfway between DNA and a nucleosome. While it looks like a nucleosome, it is in fact a distinct particle of its own, researchers say. (Credit: James Kadonaga, UC San Diego)

ScienceDaily (Aug. 18, 2011) — Basic biology textbooks may need a bit of revising now that biologists at UC San Diego have discovered a never-before-noticed component of our basic genetic material.

According to the textbooks, chromatin, the natural state of DNA in the cell, is made up of nucleosomes. And nucleosomes are the basic repeating unit of chromatin.

When viewed by a high powered microscope, nucleosomes look like beads on a string. But in the Aug. 19 issue of the journal *Molecular Cell*, UC San Diego biologists report their discovery of a novel chromatin particle halfway between DNA and a nucleosome. While it looks like a nucleosome, they say, it is in fact a distinct particle of its own.

"This novel particle was found as a precursor to a nucleosome," said James Kadonaga, a professor of biology at UC San Diego who headed the research team and calls the particle a "pre-nucleosome." "These findings suggest that it is necessary to reconsider what chromatin is. The pre-nucleosome is likely to be an important player in how our genetic material is duplicated and used."

The biologists say that while the pre-nucleosome may look something like a nucleosome under the microscope, biochemical tests have shown that it is in reality halfway between DNA and a nucleosome.

These pre-nucleosomes, the researchers say, are converted into nucleosomes by a motor protein that uses the energy molecule ATP.

"The discovery of pre-nucleosomes suggests that much of chromatin, which has been generally presumed to consist only of nucleosomes, may be a mixture of nucleosomes and pre-nucleosomes," said Kadonaga. "So, this discovery may be the beginning of a revolution in our understanding of what chromatin is."

"The packaging of DNA with histone proteins to form chromatin helps stabilize chromosomes and plays an important role in regulating gene activities and DNA replication," said Anthony Carter, who oversees chromatin grants at the National Institute of General Medical Sciences of the National Institutes of Health, which funded the research. "The discovery of a novel intermediate DNA-histone complex offers intriguing insights into the nature of chromatin and may help us better understand how it impacts these key cellular processes."

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

Journal Reference:

1. Sharon E. Torigoe, Debra L. Urwin, Haruhiko Ishii, Douglas E. Smith, James T. Kadonaga. Identification of a Rapidly Formed Nonnucleosomal Histone-DNA Intermediate that Is Converted into Chromatin by ACF. *Molecular Cell*, 2011; 43 (4): 638-648 DOI: 10.1016/j.molcel.2011.07.017

http://www.sciencedaily.com/releases/2011/08/110818142842.htm

Art Books Elevate Picassos of Pulp

By DANA JENNINGS

James Jean, "Rebus"/Chronicle Books

The painter James Jean first made his name as a comic book artist.

THE place of comic books at the cultural supper table has never been more secure. Summertime films have come to mean superhero movies. Comics-related museum shows and gallery exhibitions are a regular part of the art world palette. And the market for original comic-book art continues to be strong. Just this May a bold, full-page drawing of Batman and Robin by Frank Miller and Klaus Janson — from the groundbreaking 1986 series "Batman: The Dark Knight Returns" — sold at auction for an emphatic $448,125.

That broad cultural good news, though, is still tempered in an industry where dozens of titles used to sell hundreds of thousands of copies each month. These days only the top one or two best-selling books creep past the 100,000 mark — and in some months none at all.

But even as sales falter, comics' rising legitimacy means the genre — whether knowingly or not — can now focus more than ever on defining its four-color canon. In the old days that canon was pretty much set by price guides aimed at collectors. But a recent proliferation of well-made art volumes continues to help anchor and expand the notions of which artists matter most in the 80-year history of comic books.

Not that collections of comic book art are new. Once upon a time, however, such books were ramshackle affairs. They were often printed in black-and-white on stock maybe a cut above copier paper, and stapled together. If they were printed in hardcover color you could hear the spine glue crackle and complain the first time the books were cracked open. And the color was about as nuanced as that on a 1966 Philco floor-model color television.

But right now a quiet revolution is going on in comics art books. There are portfolio-size editions scanned directly from original artwork; artists successfully negotiating the worlds of fine, commercial and comics art; younger and less-well-known artists getting the full-color hardcover treatment; and the scholarship continues to deepen and the production values rise in books that study bedrock comic book artists like Jack Kirby, Steve Ditko and Alex Toth.

These books are aimed at serious fans of the comic book as art form, but also at those who savor good graphic design and illustration. Traditional art-book publishers like Abrams and Chronicle have a presence in this niche market — where books tend to sell in the $40-to-$50 range — alongside the comic book companies.

“There’s always been an audience within the comics market for art books by comics’ greats, and it’s something that’s definitely been on the rise the past few years, especially in lushly produced formats,” said Karen Berger, executive editor of DC Comics’ Vertigo imprint, which has led the way in the use of striking paintings on the covers of its comic books. “I think these high-quality, deluxe books speak to the fine art and strong illustration styles of these singular talents.”

Scott Dunbier, senior editor of special projects for IDW Publishing, a leader in putting out well-wrought books of comics art, says there’s a pleasure from a publisher’s point of view in having “the ability to present the art in a way you’ve never seen it before, in showcasing this very American art form beyond what can be appreciated from a comic book.

“The point, really,” he said, “is to enable people to experience something as close as possible to the original art, something very few people are able to do.”

Here’s a small gallery bristling with the pagan energies of the comic book, all pulled from current examples of comics canonization at work.

http://www.nytimes.com/2011/08/21/arts/design/comic-book-art-showcased-in-books.html

Greenland Glacier Melting Faster Than Expected

Mittivakkat Glacier. (Credit: Image courtesy of University of Sheffield)

ScienceDaily (Aug. 18, 2011) — A key glacier in Greenland is melting faster than previously expected, according to findings by a team of academics, including Dr Edward Hanna from University of Sheffield. Dr Hanna, from the University of Sheffield's Department of Geography, was part of a team of researchers that also included Dr Sebastian Mernild from the Los Alamos Laboratory, USA, and Professor Niels Tvis Knudsen from the University of Aarhus, Denmark. The team´s new findings present crucial insight into the effects of climate change.

The researchers found that Greenland's longest-observed glacier, Mittivakkat Glacier, made two consecutive record losses in mass observations for 2010 and 2011. The observations indicate that the total 2011 mass budget loss was 2.45 metres, 0.29 metres higher than the previous observed record loss in 2010. The 2011 value was also significantly above the 16-year average observed loss of 0.97 metres per year.

The 2011 observations further illustrate, even comparing the mass balance value against simulated glacier mass balance values back to 1898, that 2011 is a record-breaking glacier mass loss year.

Mittivakkat Glacier has been surveyed for mass balance and glacier front fluctuations since 1995 and 1931 respectively. In 2011 the glacier terminus has retreated about 22 metres, 12 metres less than the observed record of 34 metres in 2010, and approximately 1,300 metres in total since the first photographic observations in 1931.

These observations suggest that recent Mittivakkat Glacier mass losses, which have been driven largely by higher surface temperatures and low precipitation, are representative of the broader region, which includes many hundreds of local glaciers in Greenland. Observations of other glaciers in Greenland show terminus retreats comparable to that of Mittivakkat Glacier. These glaciers are similar to the Mittivakkat Glacier in size and elevation range.

Local glacier observations in Greenland are rare, and the Mittivakkat Glacier is the only glacier in Greenland for which long-term observations of both the surface mass balance and glacier front fluctuations exist.

Since 1995, the general trend for the Mittivakkat Glacier has been toward higher temperatures, less snowfall, and a more negative glacier mass balance, with record mass loss in 2011. In 14 of the last 16 years, the Mittivakkat Glacier had a negative surface mass balance.

Principal Investigator on this summer's fieldwork, Dr Edward Hanna, commented: "Our fieldwork results are a key indication of the rapid changes now being seen in and around Greenland, which are evident not just on this glacier but also on many surrounding small glaciers. It's clear that this is now a very dynamic environment in terms of its response and mass wastage to ongoing climate change.

"The retreat of these small glaciers also makes the nearby Greenland Ice Sheet more vulnerable to further summer warming which is likely to occur. There could also be an effect on North Atlantic Ocean circulation and weather patterns through melting so much extra ice. An extended glacier observation programme in east Greenland for the next few years is clearly needed to improve understanding of the links between climate change and response of the glaciers in this important region."

The project marks an important practical collaborative venture of both the joint research centre of the Universities of Sheffield and Aarhus, and Los Alamos, with funding support provided by the European Community´s Seventh Framework Programme.

The research was carried out with funding support provided by the European Community's Seventh Framework Programme under grant agreement No. 262693.

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

Journal Reference:

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http://www.sciencedaily.com/releases/2011/08/110818132221.htm

Moon Younger Than Previously Thought, Analysis of Lunar Rock Reveals

New analysis of lunar rock has shown that the Moon may be much younger than previously believed. (Credit: © David Woods / Fotolia)

ScienceDaily (Aug. 18, 2011) — Analysis of a piece of lunar rock brought back to Earth by the Apollo 16 mission in 1972 has shown that the Moon may be much younger than previously believed. This is concluded in new research conducted by an international team of scientists that includes James Connelly from the Centre for Star and Planet Formation, Natural History Museum of Denmark, University of Copenhagen. Their work has just been published in *Nature*.

The prevailing theory of our Moon's origin is that it was created by a giant impact between a large planet-like object and the proto-Earth very early in the evolution of our solar system. The energy of this impact was sufficiently high that the Moon formed from melted material that began with a deep liquid magma ocean.

As the Moon cooled, this magma ocean solidified into different mineral components, the lightest of which floated upwards to form the oldest crust. Analysis of a lunar rock sample of this presumed ancient crust has given scientists new insights into the formation of the Moon.

Luna rock from Apollo 16

"We have analysed a piece of lunar rock that was brought back to Earth by the Apollo 16 mission in 1972. Although the samples have been carefully stored at NASA Johnson Space Center since their return to Earth, we had to extensively pre-clean the samples using a new method to remove terrestrial lead contamination. Once we removed the contamination, we found that this sample is almost 100 million years younger than we expected," says researcher James Connelly of the Centre for Star and Planet Formation.

According to the existing theory for lunar formation, a rock type called ferroan anorthosite, also known as FAN, is the oldest of the Moon's crustal rocks, but scientists have had difficulty dating samples of this crust.

Newly-refined techniques help determine age of sample

The research team, which includes scientists from the Natural History Museum of Denmark, Lawrence Livermore National Laboratory, Carnegie Institute's Department of Terrestrial Magnetism and Université Blaise Pascal, used newly-refined techniques to determine the age of the sample of a FAN that was returned by the Apollo 16 mission and has been stored at the lunar rock collection at the NASA Johnson Space Center.

The team analysed the isotopes of the elements lead and neodymium to place the age of a sample of a FAN at 4.36 billion years. This figure is significantly younger than earlier estimates of the Moon's age that range to nearly as old as the age of the solar system itself at 4.567 billion years. The new, younger age obtained for the oldest lunar crust is similar to ages obtained for the oldest terrestrial minerals -- zircons from Western Australia -- suggesting that the oldest crust on both Earth and the Moon formed at approximately the same time.

This study is the first in which a single sample of FAN yielded consistent ages from multiple isotope dating techniques. This result strongly suggests that these ages pinpoint the time at which this sample crystallised. The extraordinarily young age of this lunar sample either means that the Moon solidified significantly later than previous estimates -- and therefore the moon itself is much younger than previously believed -- or that this sample does not represent a crystallisation product of the original magma ocean. Either scenario requires major revision to previous models for the formation of the Moon.

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

Journal Reference:

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http://www.sciencedaily.com/releases/2011/08/110817135422.htm

Polar Ice Caps Can Recover from Warmer Climate-Induced Melting, Study Shows

Freshwater ponds appear atop the Arctic ice cap during the summer melt in this image taken on July 12. The NASA-funded Impacts of Climate on Ecosystems and Chemistry of the Arctic Pacific Environment project has been examining the ponds and the ice around them this summer. (Credit: NASA)

ScienceDaily (Aug. 18, 2011) — A growing body of recent research indicates that, in Earth's warming climate, there is no "tipping point," or threshold warm temperature, beyond which polar sea ice cannot recover if temperatures come back down. New University of Washington research indicates that even if Earth warmed enough to melt all polar sea ice, the ice could recover if the planet cooled again.

In recent years scientists have closely monitored the shrinking area of the Arctic covered by sea ice in warmer summer months, a development that has created new shipping lanes but also raised concerns about humans living in the region and the survival of species such as polar bears.

In the new research, scientists used one of two computer-generated global climate models that accurately reflect the rate of sea-ice loss under current climate conditions, a model so sensitive to warming that it projects the complete loss of September Arctic sea ice by the middle of this century.

However, the model takes several more centuries of warming to completely lose winter sea ice, and doing so required carbon dioxide levels to be gradually raised to a level nearly nine times greater than today. When the model's carbon dioxide levels then were gradually reduced, temperatures slowly came down and the sea ice eventually returned.

"We expected the sea ice to be completely gone in winter at four times the current level of carbon dioxide but we had to raise it by more than eight times," said Cecilia Bitz, a UW associate professor of atmospheric sciences.

"All that carbon dioxide made a very, very warm planet. It was about 6 degrees Celsius (11 degrees Fahrenheit) warmer than it is now, which caused the Arctic to be completely free of sea ice in winter."

Bitz and members of her research group are co-authors of a paper about the research that is to be published in *Geophysical Research Letters.* The lead author is Kyle Armour, a UW graduate student in physics, and other co-authors are Edward Blanchard-Wrigglesworth and Kelly McCusker, UW graduate students in atmospheric sciences, and Ian Eisenman, a postdoctoral researcher from the California Institute of Technology and UW.

In the model, the scientists raised atmospheric carbon dioxide 1 percent each year, which resulted in doubling the levels of the greenhouse gas about every 70 years. The model began with an atmospheric carbon dioxide level of 355 parts per million (in July the actual figure stood at 392 ppm).

In that scenario, it took about 230 years to reach temperatures at which Earth was free of sea ice during winter. At that point, atmospheric carbon dioxide was greater than 3,100 parts per million.

Then the model's carbon dioxide level was reduced at a rate of 1 percent a year until, eventually, temperatures retreated to closer to today's levels. Bitz noted that the team's carbon dioxide-reduction scenario would require more than just a reduction in emissions that could be achieved by placing limits on the burning of fossil fuels. The carbon dioxide would have to be drawn out of the atmosphere, either naturally or mechanically.

"It is really hard to turn carbon dioxide down in reality like we did in the model. It's just an exercise, but it's a useful one to explore the physics of the system."

While the lack of a "tipping point" could be considered good news, she said, the increasing greenhouse gases leave plenty of room for concern.

"Climate change doesn't have to exhibit exotic phenomena to be dangerous," Bitz said, adding that while sea ice loss can have some positive effects, it is proving harmful to species such as polar bears that live on the ice and to some people who have been forced to relocate entire villages.

"The sea ice cover will continue to shrink so long as the Earth continues to warm," she said. "We don't have to hypothesize dramatic phenomena such as tipping points for this situation to become challenging."

The research was funded by the National Science Foundation, the Davidow Discovery Fund and the National Oceanic and Atmospheric Administration.

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

Journal Reference:

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http://www.sciencedaily.com/releases/2011/08/110817194235.htm

Sniffer Dogs Can Be Used to Detect Lung Cancer, Research Suggests

Sniffer dog training. (Credit: Image courtesy of European Lung Foundation)

ScienceDaily (Aug. 18, 2011) — Sniffer dogs could be used for the early detection of lung cancer, according to new research published in the *European Respiratory Journal*.

The study, carried out by researchers from Schillerhoehe Hospital in Germany, is the first to find that sniffer dogs can reliably detect lung cancer.

Lung cancer is the second most frequent form of cancer in men and women across Europe with over 340,000 deaths per year. It is also the most common cause of death from cancer worldwide.

The disease is not strongly associated with any symptoms and early detection is often by chance. Current methods of detection are unreliable and scientists have been working on using exhaled breath specimens from patients for future screening tests.

This method relies on identifying volatile organic compounds (VOCs) that are linked to the presence of cancer. Although many different technological applications have been developed, this method is still difficult to apply in a clinical setting as patients aren't allowed to smoke or eat before the test, sample analysis can take a long time and there is also a high risk of interference. Because of these reasons, no lung cancer-specific VOCs have yet been identified.

This new study aimed to assess whether sniffer dogs could be used to identify a VOC in the breath of patients. The researchers worked with 220 volunteers, including lung cancer patients, chronic obstructive pulmonary disease (COPD) patients and healthy volunteers. They used dogs that had been specifically trained.

The researchers carried out a number of tests to see if the dogs were able to reliably identify lung cancer compared with healthy volunteers, volunteers with COPD and whether the results were still found with the presence of tobacco.

The dogs successfully identified 71 samples with lung cancer out of a possible 100. They also correctly detected 372 samples that did not have lung cancer out of a possible 400.

The dogs could also detect lung cancer independently from COPD and tobacco smoke. These results confirm the presence of a stable marker for lung cancer that is independent of COPD and also detectable in the presence of tobacco smoke, food odours and drugs.

Author of the study, Thorsten Walles from Schillerhoehe Hospital, said: "In the breath of patients with lung cancer, there are likely to be different chemicals to normal breath samples and the dogs' keen sense of smell can detect this difference at an early stage of the disease. Our results confirm the presence of a stable marker for lung cancer. This is a big step forward in the diagnosis of lung cancer, but we still need to precisely identify the compounds observed in the exhaled breath of patients. It is unfortunate that dogs cannot communicate the biochemistry of the scent of cancer!"

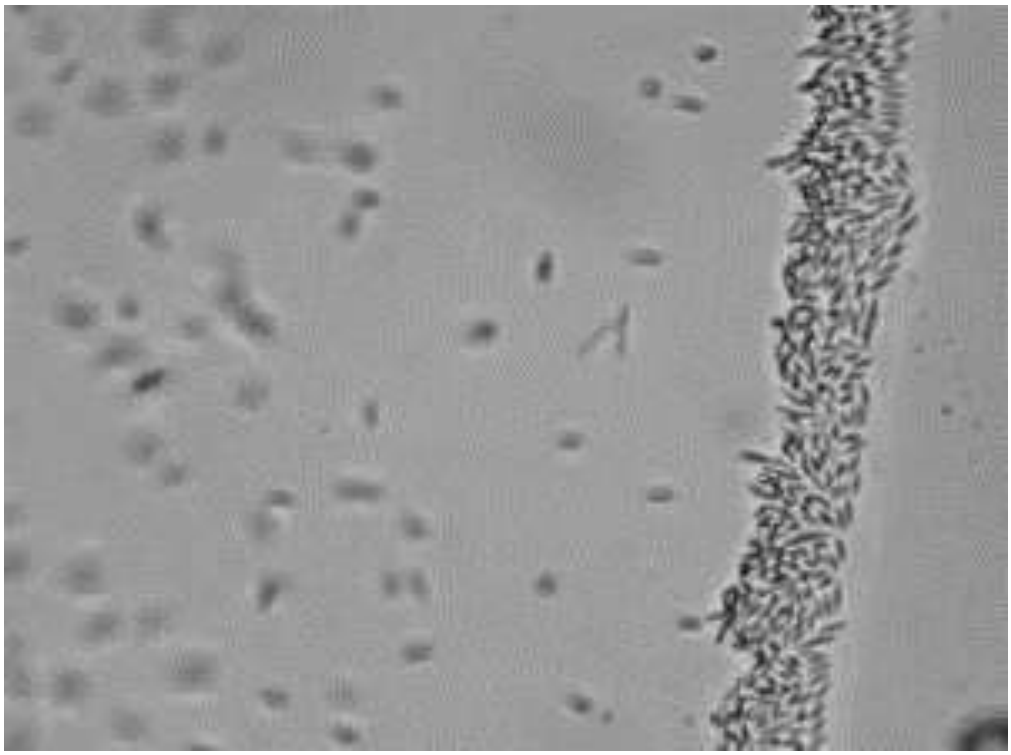
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by European Lung Foundation, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Rainer Ehmann, Enole Boedeker, Uwe Friedrich, Jutta Sagert, Jürgen Dippon, Godehard Friedel, Thorsten Walles. Canine scent detection in the diagnosis of lung cancer: Revisiting a puzzling phenomenon. *European Respiratory Journal*, 2011; DOI: 10.1183/09031936.00051711

http://www.sciencedaily.com/releases/2011/08/110817194548.htm

Physicists Undo the 'Coffee Ring Effect'



Penn physicists recently shown that simply changing particle shape can eliminate the ring-shaped stain that is left behind when drops of certain liquids dry. Video microscopy footage from their experiments shows spherical particles getting swept to the edges, while oblong particles are distributed consistently (see: http://www.youtube.com/watch?v=ZaCGoSTMHyc). (Credit: Kurtis Sensenig, University of Pennsylvania)

ScienceDaily (Aug. 17, 2011) — A team of University of Pennsylvania physicists has shown how to disrupt the "coffee ring effect" -- the ring-shaped stain of particles leftover after coffee drops evaporate -- by changing the particle shape. The discovery provides new tools for engineers to deposit uniform coatings.

The research was conducted by professor Arjun Yodh, director of the Laboratory for Research on the Structure of Matter; doctoral candidates Peter Yunker and Matthew Lohr; and postdoctoral fellow Tim Still, all of the department of Physics and Astronomy in Penn's School of Arts and Sciences.

Their research will be published in the journal *Nature* on August 18.

"The coffee ring effect is very common in everyday experience," Yunker said. "To avoid it, scientists have gone to great lengths designing paints and inks that produce an even coating upon evaporation. We found that the effect can be eliminated simply by changing the shape of the particle."

The edges of a water drop sitting on a table or a piece of paper, for example, are often "pinned" to the surface. This means that when the water evaporates, the drop can't shrink in circumference but instead flattens out. That flattening motion pushes water and anything suspended in it, such as coffee particles, to its edges. By the time the drop fully evaporates, most of the particles have reached the edge and are deposited on the surface, making a dark ring.

University of Chicago physicists Sidney Nagel, Thomas Witten and their colleagues wrote an influential paper about this process in 1997, which focused mainly on suspended spherical particles, but it was not until the Yodh team's recent experiments that the surprising role played by suspended particle shape was discovered.

Yodh's team used uniformly sized plastic particles in their experiments. These particles were initially spherical but could be stretched into varying degrees of eccentricity, to ensure the experiments only tested the effect of the particle's shape on the drying pattern.

The researchers were surprised at how big an effect particle shape had on the drying phenomenon.

"Different particle geometries change the nature of the membrane at the air-water interface," Yodh said. "And that has big consequences."

Spherical particles easily detach from the interface, and they flow past one another easily because the spheres do not substantially deform the air-water interface. Ellipsoid particles, however, cause substantial undulation of the air-water interface that in turn induces very strong attractions between the ellipsoids. Thus the ellipsoids tend to get stuck on the surface, and, while the stuck particles can continue to flow towards the drop's edges during evaporation, they increasingly block each other, creating a traffic jam of particles that eventually covers the drop's surface.

"Once you stretch the spherical particles by about 20 percent," Yunker said, "the particles deposit uniformly."

After experimenting with suspended particle shape, the researchers added a surfactant, essentially soap, into the drops to show that interactions on the drop's surface were responsible for the effect. With the surfactant lowering the drop's surface tension, ellipsoid particles did not get stuck at the interface and flowed freely to the edge.

They also tested drops that had mixtures of both spherical and oblong particles. When the spheres were much smaller than the ellipsoids, the spheres flowed to the edge, but, at a certain size, they became similarly trapped.

"We were thinking it would be useful if you could just sprinkle in a few of these ellipsoid particles to remove the coffee ring effect," Yodh said, "and we found that sometimes this idea works and sometimes it doesn't."

Understanding the impact of particle shape on drop drying could have applications in printing and painting. The principles could also be relevant in biological and medical contexts.

"In many cases, the way we make coatings involves hazardous chemicals," Yunker said. "If you need something that's bio-compatible, it's more difficult."

"There are a lot of situations where you want uniform coatings," he said. "This work will stimulate people to think about new ways of doing it."

This research was supported by the National Science Foundation, including its Materials Research Science and Engineering Center; NASA; and the CNRS-Rhodia-UPenn Complex Assemblies of Soft Matter collaboration.

Story Source:

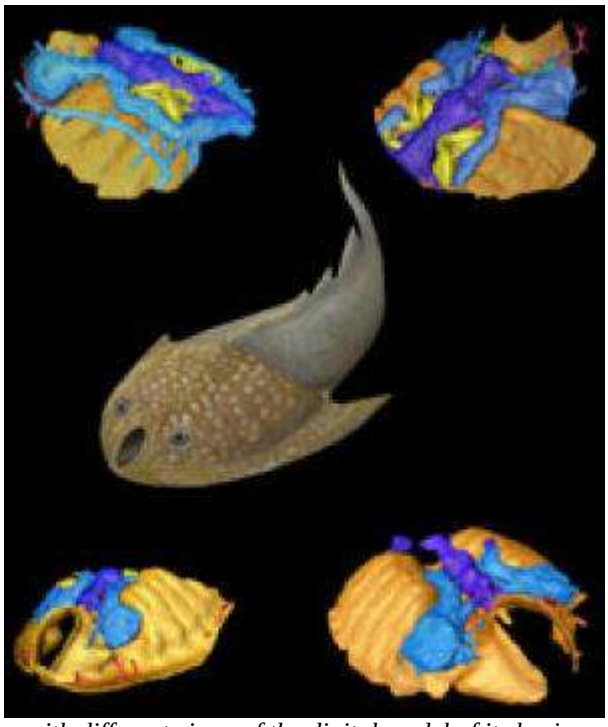
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by University of Pennsylvania.

Journal Reference:

1. Peter J. Yunker, Tim Still, Matthew A. Lohr, A. G. Yodh. Suppression of the coffee-ring effect by shape-dependent capillary interactions. *Nature*, 2011; 476 (7360): 308 DOI: 10.1038/nature10344

http://www.sciencedaily.com/releases/2011/08/110817135353.htm

Getting Inside the Mind (and Up the Nose) of Our Ancient Ancestors



Artistic reconstruction of the galeaspid animal together with different views of the digital model of its brain and sense organs. (Credit: Image courtesy of University of Bristol)

ScienceDaily (Aug. 17, 2011) — Reorganisation of the brain and sense organs could be the key to the evolutionary success of vertebrates, one of the great puzzles in evolutionary biology, according to a paper by an international team of researchers, published August 17 in *Nature*.

The study claims to have solved this scientific riddle by studying the brain of a 400 million year old fossilized jawless fish -- an evolutionary intermediate between the living jawless and jawed vertebrates (animals with backbones, such as humans).

Palaeontologists and physicists from the University of Bristol (UK), the Institute of Vertebrate Palaeontology and Palaeoanthropology (IVPP, China), Museum national d'Histoire naturelle (Paris, France) and the Paul Scherrer Institut (Switzerland) collaborated to study the structure of the head of a primitive fossil jawless fish called a galeaspid.

Instead of breaking the fossil up, they studied it using high energy X-rays at the Swiss Light Source in Switzerland, revealing the shape of the animal's brain and sense organs.

Lead author, Gai Zhi-kun of the University of Bristol and the IVPP, China, said "We were able to see the paths of all the veins, nerves and arteries that plumbed the brain of these amazing fossils. They had brains much like living sharks -- but no jaws."

The origin of a mouthful of jaws and teeth is one of the biggest steps in our evolutionary history but fossils have not provided any insights -- until now.

Zhi-kun continued: "We've been able to show that the brain of vertebrates was reorganised before the evolutionary origin of jaws."

Co-author, Professor Philip Donoghue of the University of Bristol's School of Earth Sciences said: "In the embryology of living vertebrates, jaws develop from stem cells that migrate forwards from the hindbrain, and down between the developing nostrils. This does not and cannot happen in living jawless vertebrates because they have a single nasal organ that simply gets in the way."

Professor Min Zhu of IVPP continued: "This is the first real evidence for the steps that led to the evolutionary origin of jawed vertebrates, and the fossil provides us with rock solid proof."

Professor Philippe Janvier of the Museum national d'Histoire naturelle, Paris, said: "This research has been held back for decades, waiting for a technology that will allow us to see inside the fossil without damaging it. We could not have done this work without this crazy collaboration between palaeontologists and physicists."

Professor Marco Stampanoni of the Paul Scherrer Insitut, the location of the Swiss Light Source said: "We used a particle accelerator called synchrotron as X-ray source for performing non destructive 3D microscopy of the sample. It allowed us to make a perfect computer model of the fossil that we could cut up in any way that we wanted, but without damaging the fossil in any way. We would never have got permission to study the fossil otherwise!"

This work was funded by the Royal Society, the Natural Environment Research Council, the Chinese Academy of Sciences, the Chinese Foundation of Natural Sciences, EU Framework Programme 7, and the Paul Scherrer Institut.

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

Journal Reference:

1. Zhikun Gai, Philip C. J. Donoghue, Min Zhu, Philippe Janvier, Marco Stampanoni. Fossil jawless fish from China foreshadows early jawed vertebrate anatomy. *Nature*, 2011; 476 (7360): 324 DOI: 10.1038/nature10276

http://www.sciencedaily.com/releases/2011/08/110817135351.htm

And a Frog Shall Lead Them: Henson's Legacy

By LAUREL GRAEBER

Chester Higgins Jr./The New York Times
Kermit the Frog welcomes visitors to "Jim Henson's Fantastic World" at the Museum of the Moving Image in Astoria, Queens

COOKIE MONSTER has an important lesson for Don Draper.

If you're wondering what a fuzzy blue Muppet, adored by millions of children, could possibly have to do with the debonair protagonist of television's "Mad Men," you'll have to visit the Museum of the Moving Image in Astoria, Queens. Its new exhibition "Jim Henson's Fantastic World" shows that Henson, the designer, puppeteer and filmmaker probably best known for "Sesame Street" and "The Muppet Show," was once quite a Mad Man himself.

Cookie Monster evolved from the Wheel Stealer, one of several puppet creatures Henson invented who consume a family's snacks in a 1960s television commercial. He later appeared on TV chomping an I.B.M. computer. According to the exhibition, Henson had hit on something that the era's advertising mavens had hardly considered: Humor sells products.

"He was also making fun of Madison Avenue and the way things were sold, and yet he was very successful at it," Karen Falk, the show's curator, said in an interview. "He was much loved by the Madison Avenue executives. Maybe having it come from a puppet character made it O.K."

Henson the subversive advertising genius is just one of the lesser-known identities the exhibition reveals. It also portrays Henson the graphic designer, Henson the product of the '60s counterculture, Henson the experimental filmmaker and Henson the creative collaborator. The 3,500-square-foot show, consisting of more than 120 artifacts, has come to New York as its last stop on a four-year tour organized by the Smithsonian Institution Traveling Exhibition Service. Tracing Henson's development from his Mississippi

childhood and Maryland high school and college years until his death from a bacterial infection in New York in 1990 (he was only 53), it comprises — along with a wealth of film and video — sketches, notes, photographs, television pitches, storyboards, and even doodles and office memos.

"A lot of this material I found in boxes Jim had saved and labeled 'Old Production Files,' " said Craig Shemin, president of the Jim Henson Legacy, the organization that created the exhibition with the Smithsonian. "Jim saved everything." When Mr. Shemin was working for the Jim Henson Company in the 1990s, "the production department said, 'Oh, we don't need these,' " he recalled, referring to the boxes. The trove went into the company archives, which Ms. Falk directs.

"There hadn't been a traveling exhibition particularly devoted to Jim, ever," said Ms. Falk, who broached the idea to the Smithsonian with Henson's widow, Jane Henson. "The other shows that have gone up were much more about the Muppets."

Not that "Jim Henson's Fantastic World" lacks Muppets. Its more than a dozen examples include Kermit, the unflappable, easygoing frog whom Henson regarded as his alter ego; Bert and Ernie, the "Sesame Street" pals who embodied Henson's comedic partnership with the puppeteer Frank Oz; Rowlf the dog, the first nationally known Muppet, who went from dog food commercials to "The Jimmy Dean Show"; the wise minstrel Cantus from "Fraggle Rock," another Henson stand-in; and the inimitable Miss Piggy, absent from most of the tour but resplendent here in a wedding dress. (She had not been available until the show was nearing its end, said Bonnie Erickson, the designer who created her and the executive director of the Jim Henson Legacy. "But she's delighted to be in New York and on display.")

The entire exhibition, let alone Miss Piggy, almost didn't make it to Queens; the tour was to conclude before the Museum of the Moving Image reopened in January after an extensive renovation. But Carl Goodman, the museum's executive director, passionately wanted the show: Henson's company and his creative home were just blocks away. Being an added stop has brought benefits. The exhibition runs in New York a full six months, twice as long as anywhere else.

"Other institutions who've hosted it would treat it as a kids' exhibition and have programs just for younger people," Mr. Goodman said. "We've been heartened to see that kids do love it and that we didn't have to bring it down to their level."

Instead the museum has devised programs, many for adults, featuring Henson's collaborators as leaders and guests. They include "Look Both Ways and Go" (Sept. 18), an afternoon with Jane Henson, her husband's original creative partner; "Muppet Music Moments: A Weekend Celebration of Jim Henson's Birthday" (Sept. 24 and 25), with the music consultant Larry Grossman; and "Being Elmo: A Puppeteer's Journey" (Sept. 25), a screening of a film about the "Sesame Street" puppeteer Kevin Clash, which he and the director, Constance Marks, will attend. This Saturday and Sunday the museum offers "Sound Effects," an interactive family workshop about "The Muppet Movie."

With its multiple theaters, the museum can also enhance the exhibition in ways not possible elsewhere. Screenings will feature Henson projects outside the show's main focus, like the science-fiction film "The Labyrinth" (1986) and episodes from his 1980s TV series "The Storyteller" and "The Jim Henson Hour."

"The story of how he developed his thinking process and how his creativity grew from that make up the core of our show," said Deborah Macanic, the project director at the Smithsonian. "If we had focused a lot on individual film projects, we wouldn't have been able to tell that story."

While the exhibition has an excerpt from "Time Piece" (1965), an Oscar-nominated short that Henson wrote, directed and starred in, only this museum has devoted an amphitheater to screening the whole nine-minute

work continuously (through Sept. 30). A surreal, nonlinear film depicting its harried protagonist in places including the hospital, the street and the jungle, it was, Henson said, "the story of Everyman, frustrated by the typical tasks of a typical day." No Muppets, no sunny songs.

Another surprise is the many displays of unrealized projects. But Henson often adapted early rejected concepts into later successful ones. Elements of "The Zoocus," for instance, an unproduced 1960 variety show, turn up in "The Muppet Show" some 15 years later. "Jim never wasted an idea," Ms. Falk said.

The show highlights Henson above all as a television pioneer. He was one of the first to use soft material for puppets, which allowed more expressivity on screen. (He made the original Kermit from his mother's old coat and a Ping-Pong ball.) He was also among the first puppeteers to synchronize his voice with his hand movements, said Cheryl Henson, president of the Jim Henson Foundation and one of his five children. And he devised other innovations by putting operators inside his creations. "He was always excited by the potential of puppetry," she said. "He never saw it as a limited form just for young children."

The exhibition, which shows Henson experimenting with new puppet types in the fantasy film "The Dark Crystal" (1982), ends with a montage of film and television clips that include interviews with him and illustrate his approach, both playful and serious.

"He liked to say, 'unlike anything ever done before,' " Cheryl Henson said. "It's kind of a Barnum & Bailey statement, but he always said that that was what the work had to be."

"Jim Henson's Fantastic World" runs through Jan. 16 at the Museum of the Moving Image, 35th Avenue at 36th Street, Astoria, Queens; (718) 777-6800, movingimage.us.

http://www.nytimes.com/2011/08/19/arts/design/jim-hensons-fantastic-world-at-museum-of-the-moving-image.html

Most Primitive Living Eel Discovered: Creating a New Species, Genus and Family of Animal

Scientists at the Smithsonian and partnering organizations have discovered a remarkably primitive eel in a fringing reef off the coast of the Republic of Palau. This fish exhibits many primitive anatomical features unknown in the other 19 families and more than 800 species of living eels, resulting in its classification as a new species belonging to a new genus and family. (Credit: Jiro Sakaue)

ScienceDaily (Aug. 17, 2011) — Scientists at the Smithsonian and partnering organizations have discovered a remarkably primitive eel in a fringing reef off the coast of the Republic of Palau. This fish exhibits many primitive anatomical features unknown in the other 19 families and more than 800 species of living eels, resulting in its classification as a new species belonging to a new genus and family.

The team's research is published online in the *Proceedings of the Royal Society B*, Aug. 17.

Many of the physical features of this new genus and species of eel, Protoanguilla palau, reflect its relationship to the 19 families of Anguiliformes (true eels) currently living. Other, more primitive physical traits, such as a second upper jaw bone (premaxilla) and fewer than 90 vertebrae, have only been found in fossil forms from the Cretaceous period (140 million to 65 million years ago). Still other traits, such as a full set of bony toothed "rakers," in the gill arches are a common feature in most bony fishes, but lacking in both fossil and living eels. The team's analyses of total mitochondrial DNA indicate that P. palau represents an ancient, independent lineage with an evolutionary history comparable to that of the entire order of living and fossil eel species.

"The equivalent of this primitive eel, in fishes, has perhaps not been seen since the discovery of the coelacanth in the late 1930s," said Dave Johnson, ichthyologist at the Smithsonian's National Museum of Natural History and lead author of the team's research. "We believe that such a long, independent evolutionary history, dating back to the early Mesozoic (about 200 million years ago), retention of several primitive anatomical features and apparently restricted distribution, warrant its recognition as a living fossil."

Anguilliformes, a distinct group of bony fishes, first appeared in the fossil record about 100 million years ago. They eventually lost their pelvic fins, and their dorsal, anal and caudal fins became continuous. Living eels are very diverse and can be found in a large variety of habitats -- from shallow coastal waters to the deep open ocean.

"The discovery of this extraordinary and beautiful new species of eel underscores how much more there is to learn about our planet," Johnson said. "Furthermore, it brings home the critical importance of future conservation efforts -- currently this species is known from only 10 specimens collected from a single cave in Palau."

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

Journal Reference:

1. G. D. Johnson, H. Ida, J. Sakaue, T. Sado, T. Asahida, M. Miya. A 'living fossil' eel (Anguilliformes: Protoanguillidae, fam. nov.) from an undersea cave in Palau. *Proceedings of the Royal Society B: Biological Sciences*, 2011; DOI: 10.1098/rspb.2011.1289

http://www.sciencedaily.com/releases/2011/08/110817120233.htm

It's a Small World, After All: Earth Is Not Expanding, NASA Research Confirms

This view of Earth comes from NASA's Moderate Resolution Imaging Spectroradiometer aboard the Terra satellite. (Credit: NASA)

ScienceDaily (Aug. 17, 2011) — A NASA-led research team has confirmed what Walt Disney told us all along: Earth really is a small world, after all.

Since Charles Darwin's time, scientists have speculated that the solid Earth might be expanding or contracting. That was the prevailing belief, until scientists developed the theory of plate tectonics, which explained the large-scale motions of Earth's lithosphere, or outermost shell. Even with the acceptance of plate tectonics half a century ago, some Earth and space scientists have continued to speculate on Earth's possible expansion or contraction on various scientific grounds.

Now a new NASA study, published recently in *Geophysical Research Letters*, has essentially laid those speculations to rest. Using a cadre of space measurement tools and a new data calculation technique, the team detected no statistically significant expansion of the solid Earth.

So why should we care if Mother Nature is growing? After all, Earth's shape is constantly changing. Tectonic forces such as earthquakes and volcanoes push mountains higher, while erosion and landslides wear them down. In addition, large-scale climate events like El Nino and La Nina redistribute vast water masses among Earth's ocean, atmosphere and land.

Scientists care because, to put movements of Earth's crust into proper context, they need a frame of reference to evaluate them against. Any significant change in Earth's radius will alter our understanding of our planet's physical processes and is fundamental to the branch of science called geodesy, which seeks to measure Earth's shape and gravity field, and how they change over time.

To make these measurements, the global science community established the International Terrestrial Reference Frame. This reference frame is used for ground navigation and for tracking spacecraft in Earth orbit. It is also used to monitor many aspects of global climate change, including sea level rise and its sources;

imbalances in ice mass at Earth's poles; and the continuing rebound of Earth's surface following the retreat of the massive ice sheets that blanketed much of Earth during the last Ice Age.

But measuring changes in Earth's size hasn't exactly been easy for scientists to quite literally "get their arms around." After all, they can't just wrap a giant tape measure around Earth's belly to get a definitive reading. Fortunately, the field of high-precision space geodesy gives scientists tools they can use to estimate changes in Earth's radius. These include:

- Satellite laser ranging -- a global observation station network that measures, with millimeter-level precision, the time it takes for ultrashort pulses of light to travel from the ground stations to satellites specially equipped with retroreflectors and back again.
- Very-long baseline interferometry -- a radio astronomy technology that combines observations of an object made simultaneously by many telescopes to simulate a telescope as big as the maximum distance between the telescopes.
- Global Positioning System -- the U.S.-built space-based global navigation system that provides users around the world with precise location and time information.
- Doppler Orbitography and Radiopositioning Integrated by Satellite -- a French satellite system used to determine satellite orbits and positioning. Beacons on the ground emit radio signals that are received by satellites. The movement of the satellites causes a frequency shift of the signal that can be observed to determine ground positions and other information.

Scientists use all these techniques to calculate the International Terrestrial Reference Frame. Central to the reference frame is its point of origin: the precise location of the average center of mass of the total Earth system (the combination of the solid Earth and the fluid envelope of ocean, ice and atmosphere that surrounds it, around which all Earth satellites orbit). Scientists currently determine this origin point based on a quarter century of satellite laser ranging data, considered the most accurate space geodetic tool for this purpose.

But the accuracy of the satellite laser ranging data and all existing space geodesy technologies is contaminated, both by the effects of other major Earth processes, and limited ground measurement sites. Think of it this way: if all of Earth's GPS stations were located in Norway, their data would indicate that Earth is growing, because high-latitude countries like Norway are still rising in elevation in response to the removal of the weight of Ice Age ice sheets. So how can scientists be sure the reference frame is accurate?

Enter an international group of scientists led by Xiaoping Wu of NASA's Jet Propulsion Laboratory, Pasadena, Calif., and including participants from the Institut Geographique National, Champs-sur-Marne in France, and Delft University of Technology in The Netherlands. The team set out to independently evaluate the accuracy of the International Terrestrial Reference Frame and shed new light on the Earth expansion/contraction theory.

The team applied a new data calculation technique to estimate the rate of change in the solid Earth's average radius over time, taking into account the effects of other geophysical processes. The previously discussed geodetic techniques (satellite laser ranging, very-long baseline interferometry and GPS) were used to obtain data on Earth surface movements from a global network of carefully selected sites. These data were then combined with measurements of Earth's gravity from NASA's Gravity Recovery and Climate Experiment (GRACE) spacecraft and models of ocean bottom pressure, which help scientists interpret gravity change data over the ocean.

The result? The scientists estimated the average change in Earth's radius to be 0.004 inches (0.1 millimeters) per year, or about the thickness of a human hair, a rate considered statistically insignificant.

"Our study provides an independent confirmation that the solid Earth is not getting larger at present, within current measurement uncertainties," said Wu.

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

Journal Reference:

1. X. Wu, X. Collilieux, Z. Altamimi, B. L. A. Vermeersen, R. S. Gross, I. Fukumori. Accuracy of the International Terrestrial Reference Frame origin and Earth expansion. *Geophysical Research Letters*, 2011; 38 (13) DOI: 10.1029/2011GL047450

http://www.sciencedaily.com/releases/2011/08/110817120527.htm

Oldest Evidence of Nails in Modern Primates

In a new study published online in the current edition of the American Journal of Physical Anthropology, University of Florida scientists help describe more than 25 new specimens of Teilhardina brandti, a primitive extinct primate that would have resembled the mouse lemur, seen here. (Credit: Photo copyright David Haring/Duke Lemur Center)

ScienceDaily (Aug. 17, 2011) — From hot pink to traditional French and Lady Gaga's sophisticated designs, manicured nails have become the grammar of fashion. But they are not just pretty -- when nails appeared on all fingers and toes in modern primates about 55 million years ago, they led to the development of critical functions, including finger pads that allow for sensitive touch and the ability to grasp, whether it's a nail polish brush or remover to prepare for the next trend.

In a new study co-authored by University of Florida scientists, researchers recovered and analyzed the oldest fossil evidence of fingernails in modern primates, confirming the idea nails developed with small body size and disproving previous theories nails evolved with an increase in primate body size. More than 25 new specimens of Teilhardina brandti -- an extinct primate originally described from a single lower molar -- include pieces of upper teeth and ankle bones that show the mammal lived in trees. Its nails allowed the lemur-like animal to grasp onto branches and move through the trees with more agility, researchers said.

"If you take all the primates that are alive today, they're all going to have characteristics that look the same, but unlike people, many of them live in trees," said co-author Jonathan Bloch, an associate curator of vertebrate paleontology at the Florida Museum of Natural History on the UF campus. "By finding parts of the

skeleton of this primitive primate, we are able to test whether nails were present in the common ancestor of the group that includes lemurs, monkeys, and humans -- it's direct evidence as opposed to speculation."

Appearing in the current online edition of the *American Journal of Physical Anthropology*, the study provides a better understanding of the evolutionary relationships of one of the oldest known modern primates, as well as the time frame and environmental conditions that allowed for the development of nails on all fingers and toes, an exclusive feature among primates.

Specimens of *T. brandt*i were collected over the last seven years in northwestern Wyoming's Bighorn Basin and represent the earliest North American species from the group of euprimates, also known as "true" primates. The fossils date to the early Eocene epoch, about 55.8 million years ago, at the same time as a 200,000-year global warming event known as the Paleocene-Eocene Thermal Maximum occurred, Bloch said. Mammals evolved to be smaller during that time, when even- and odd-toed hoofed mammals, distantly related to modern deer and horses, also first appeared in the fossil record.

"The appearance of the first modern primates in North America co-occurred with the appearance of other modern mammals such as horses, and it's all associated with a major global warming event," said co-author Stephen Chester, a Yale University doctoral student and research associate at UF. "It in part set the stage for what we see today in terms of modern mammalian biodiversity."

Less than 6 inches long, *T. brandt*i was omnivorous, Bloch said. While archaic primates mostly had claws, some of the characteristics of modern primates include forward-facing eyes, an enlarged brain and nails on all digits.

"They are the smallest true nails known on record, whether living or fossil," said first author Ken Rose, a professor in the Center for Functional Anatomy & Evolution at Johns Hopkins University School of Medicine. "That certainly doesn't suggest nails developed with larger bodies."

Based on the age of the fossils and analyses of Teilhardina species from other parts of the world, researchers were also able to analyze the hypothesis that mammals migrated from Asia into North America. Instead, they likely passed from Asia, through Europe and into North America on high-latitude land connections.

"This research really suggests that we are looking at something extremely close [to the species found in Europe] and that's of great interest in itself," Rose said. "We can show these species were extremely close morphologically in time and found in Europe and Wyoming."

During the Paleocene-Eocene Thermal Maximum, average temperatures were about 15 degrees Fahrenheit higher than today, and the large variety of mammals found in the fossil record from that time remains a mystery to scientists.

"The finding of this animal and the concentrated effort of this period of time might be one of those things where the closer you look, the less you know," said Gregg Gunnell, director of the Division of Fossil Primates at the Duke Lemur Center. "But any time we have the opportunity to add more morphological information to analyze the relationships of animals to answer these biogeographic questions, we can hopefully get closer and closer to an understanding of what led to this big radiation (diversification) of primates in the first place."

Study co-authors also include Rachel Dunn of Johns Hopkins University and Doug Boyer of Brooklyn College, City University of New York. The research was supported by the National Science Foundation and Yale University.

Story Source:

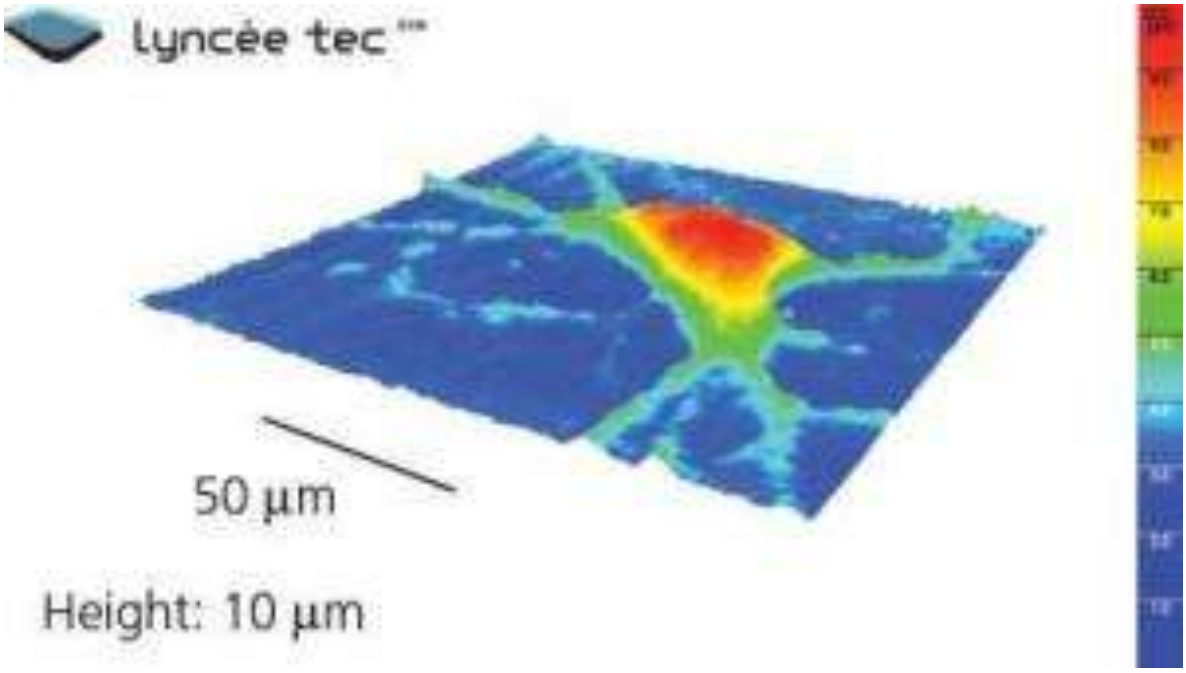
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by University of Florida. The original article was written by Danielle Torrent.

Journal Reference:

1. Kenneth D. Rose, Stephen G.B. Chester, Rachel H. Dunn, Doug M. Boyer, Jonathan I. Bloch. New fossils of the oldest North American euprimate Teilhardina brandti (Omomyidae) from the paleocene-eocene thermal maximum. *American Journal of Physical Anthropology*, 2011; DOI: 10.1002/ajpa.21579

http://www.sciencedaily.com/releases/2011/08/110815162427.htm

Holograms Reveal Brain's Inner Workings: Microscopy Technique Used to Observe Activity of Neurons Like Never Before



This is a 3-D image of living neuron taken by DHM technology. (Credit: Courtesy of Lyncée Tec)

ScienceDaily (Aug. 17, 2011) — Like far away galaxies, powerful tools are required to bring the minute inner workings of neurons into focus. Borrowing a technique from materials science, a team of neurobiologists, psychiatrists, and advanced imaging specialists from Switzerland's EPLF and CHUV report in The *Journal of Neuroscience* how Digital Holographic Microscopy (DHM) can now be used to observe neuronal activity in real-time and in three dimensions -- with up to 50 times greater resolution than ever before. The application has immense potential for testing out new drugs to fight neurodegenerative diseases such as Alzheimer's and Parkinson's.

Neurons come in various shapes and are transparent. To observe them in a Petri dish, scientists use florescent dyes that change the chemical composition and can skew results. Additionally, this technique is time consuming, often damages the cells, and only allows researchers to examine a few neurons at a time. But these newly published results show how DHM can bypass the limitations of existing techniques.

"DHM is a fundamentally novel application for studying neurons with a slew of advantages over traditional microscopes," explains Pierre Magistretti of EPFL's Brain Mind Institute and a lead author of the paper. "It is non-invasive, allowing for extended observation of neural processes without the need for electrodes or dyes that damage cells."

Senior team member Pierre Marquet adds, "DHM gives precious information not only about the shape of neurons, but also about their dynamics and activity, and the technique creates 3D navigable images and increases the precision from 500 nanometers in traditional microscopes to a scale of 10 nanometers."

A good way to understand how DHM works is to imagine a large rock in an ocean of perfectly regular waves. As the waves deform around the rock and come out the other side, they carry information about the rock's shape. This information can be extracted by comparing it to waves that did not smash up against the rock, and an image of the rock can be reconstructed. DHM does this with a laser beam by pointing a single wavelength

at an object, collecting the distorted wave on the other side, and comparing it to a reference beam. A computer then numerically reconstructs a 3D image of the object -- in this case neurons -- using an algorithm developed by the authors. In addition, the laser beam travels through the transparent cells and important information about their internal composition is obtained.

Normally applied to detect minute defects in materials, Magistretti, along with DHM pioneer and EPFL professor in the Advanced Photonics Laboratory, Christian Depeursinge, decided to use DHM for neurobiological applications. In the study, their group induced an electric charge in a culture of neurons using glutamate, the main neurotransmitter in the brain. This charge transfer carries water inside the neurons and changes their optical properties in a way that can be detected only by DHM. Thus, the technique accurately visualizes the electrical activities of hundreds of neurons simultaneously, in real-time, without damaging them with electrodes, which can only record activity from a few neurons at a time.

A major advance for pharmaceutical research

Without the need to introduce dyes or electrodes, DHM can be applied to High Content Screening -- the screening of thousands of new pharmacological molecules. This advance has important ramifications for the discovery of new drugs that combat or prevent neurodegenerative diseases such as Parkinson's and Alzheimer's, since new molecules can be tested more quickly and in greater numbers.

"Due to the technique's precision, speed, and lack of invasiveness, it is possible to track minute changes in neuron properties in relation to an applied test drug and allow for a better understanding of what is happening, especially in predicting neuronal death," Magistretti says. "What normally would take 12 hours in the lab can now be done in 15 to 30 minutes, greatly decreasing the time it takes for researchers to know if a drug is effective or not."

The promise of this technique for High Content Screening has already resulted in a start-up company at EPFL called LynceeTec (www.lynceetec.com).

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by Ecole Polytechnique Fédérale de Lausanne.

Journal Reference:

1. Pascal Jourdain, Nicolas Pavillon, Corinne Moratal, Daniel Boss, Benjamin Rappaz, Christian Depeursinge, Pierre Marquet, and Pierre J. Magistretti. Determination of Transmembrane Water Fluxes in Neurons Elicited by Glutamate Ionotropic Receptors and by the Cotransporters KCC2 and NKCC1: A Digital Holographic Microscopy Study. *Journal of Neuroscience*, 2011; 31 (33): 11846

http://www.sciencedaily.com/releases/2011/08/110816171734.htm

You Must Remember This

By HOLLAND COTTER

Kevin Jerome Everson and Picture Palace Pictures

More Than That: Films by Kevin Jerome Everson, at the Whitney Museum of American Art. Above, a still from "Act One — Betty and the Candle" (2011).

Kevin Jerome Everson's short films about ordinary African-American life are completely unordinary. Yet despite their frequent appearance in film festivals and on museum film programs, they have yet to sink fully into art world consciousness. Even when Mr. Everson's striking seven-minute "Emergency Needs" was in the 2008 Whitney Biennial, it was sidelined, as biennial films often are, by the objects in the galleries.

As if to make up for this, the museum has organized a small solo show called "More Than That: Films by Kevin Jerome Everson," made up of 17 brief films (technically, films transferred to video) projected on four walls of a screening room. Some of the films seem to be purely archival and topical, others simply and casually anecdotal, though as one quickly learns, "pure," "simple" and "casual" are not words in Mr. Everson's aesthetic vocabulary.

The 2007 film called "According to" opens with a shot of an elderly African-American man coming out onto his front porch in Cleveland to collect the daily newspaper left at the door. He herds his dog back inside, then sits down to reminisce about how, as a youth, he too delivered papers. (Mr. Everson was born in 1965 about 80 miles from Cleveland in Mansfield, Ohio, a once-prosperous rust-belt manufacturing town that, like Cleveland, was a goal for Southern blacks during the Great Migration earlier in the 20th century.)

The film, only eight and a half minutes long, then cuts to vintage television news footage. In one segment we see a body being pulled from a lake as a newscaster's voice reports on the accidental death by drowning of a black man. The same voice then tells us of a woman's death in a house fire, also accidental, in an African-American neighborhood, and we see what might be her figure lying among smoldering ruins.

Then both reports are repeated but with crucial changes. The drowned man, we're now informed, is suspected to have died as a result of foul play, and police aid was slow in arriving. The fire was believed to be arson; several white men were seen lurking around the house just before it started.

Finally we return to the porch but with a slight step-back in time, so we see the newspaper being delivered to the door by a little girl, who dashes away. The man emerges as before, but immediately repeats his entrance twice again, as if rehearsing under direction. He sits to talk, but when prompted to speak of the past he can only say, "I don't remember."

If Mr. Everson often presents the failure to remember the past as a problem, he also suggests that the failure to understand history when you're living in the middle of it can be an even greater one. A film called "Something Else" is made up entirely of archival material, a video clip from the early 1970s, in which a young woman who has just been crowned Miss Black Roanoke, Va., is being interviewed by a white reporter.

After the customary "how does it feel to win?" questions the reporter asks whether she would prefer to be in a racially integrated event. She drops her cheerful poise for an instant and carefully picks her way through an answer: It's not a matter of preference. Black contestants don't have a prayer of winning in "regular" pageants. Only segregated contests offer black women a chance of feeling "up," as she says with a smile. If you want to win, and she does, segregation is the only way to go.

In those real-life seconds of film a huge tangle of American social contradiction lands squarely in front of us. And we're left, heads spinning, trying to parse her conflicted feelings, guess at the feelings of the interviewer and come to terms with our own reactions in the present to a confounding past.

Occasionally Mr. Everson adds yet another layer of complication to his work by fabricating events that he appears to be documenting. In "American Motor Company" (2010), two workmen are in the process of putting up a billboard advertisement for "Volkswagen Ohio." In that giant ad an African-American man wearing a Black Panther-style beret poses beside a car, accompanied by the words "There's a bit of the cool in every bug."

We might think: yes, the corporate marketing of radicalism, the destabilizing of potential political power with a promise of consumer power, or some such extrapolation. In reality the advertisement was entirely Mr. Everson's invention. He designed it, commissioned its production and hired the workers to install it, all to make a five-minute film that was, as much as anything, to put a bug in the concept of coolness, no matter who's selling it.

Coolness, in the fashion sense, isn't Mr. Everson's mode, though objectivity can be — bits of life served up plain, without comment. In one video two young men engage in a classical fencing match that goes on for about 10 minutes then stops abruptly. In another, "The Equestrians," young black men ride horses on what looks like a farm or ranch. (Mr. Everson is currently completing a film about African-American cowboys and rodeo riders in the South.) And in "Old Cat" two men glide down a river on an open boat.

And glide is all they do. They don't talk; they barely move. At first you cast around for a narrative hook, a "Huckleberry Finn" angle or some significance in the fact that one man has his leg in a cast. Then you give up on that. People are just doing what they're doing. Who knows why? We're just watching life, and life can be pretty boring, as all three of these videos are, taken on their own. Yet they acquire interest within the totality

of Mr. Everson's film work and within the totality of the show — organized by the Whitney curator Chrissie Iles — which keeps generating surprises. One has to do with class. In most of the films we're clearly in a working-class world. But where are we in the fencing film or even the equestrian film? Hard to say.

And what to do, once we've decided everything's going to be about African-American subjects, with something like "Blind Huber," named for a 2002 book of poems by Nick Flynn that is an extended meditation on the metaphysics of beekeeping from the points of view both of a blind 18th-century beekeeper and the bees themselves? In the film we're bees inside a hive as the poet, in a voice-over, describes a house so filled with honey that its walls are about to burst.

This vision is fantastic in every sense, and Mr. Everson has come up with others just as wild. One film, not on view, is about the perils of light, as described from the perspective of a moth. In the split-screen 2008 Whitney biennial film, we see, on one screen, a 1968 documentary video of Carl B. Stokes, then mayor of Cleveland, speaking to the press after an explosion of racial violence; on the other screen, a woman, an actor, repeats Stokes's impassioned words and gestures. A social tragedy becomes a call-and-response opera. Public history is theater.

So is ordinary life, as embodied in two virtually eventless films that frame and ground everything else in the show. In one, "Ninety Three," which plays more or less continuously, we see a 93-year-old man in a darkened room trying to blow out candles on a huge birthday cake and finally succeeding. In the other film, "Act One — Betty and the Candle," a young girl gazes steadily into the flame of single flickering candle for almost 12 minutes.

The two films connect various dots, personal, political, historical and fictional. The man blowing out the candle is the same man who collected a newspaper on his porch and had trouble remembering the past in "According to." He's old enough to have participated in the Great Migration. The light-gazing girl is the one, now three years older, who delivered the paper in the same film. Both are members of Mr. Everson's family. (The girl, Matilda, is his daughter.) Other family and friends appear in different pieces.

The exhibition itself is dedicated to the memory of DeCarrio Antwan Couley, Mr. Everson's son, who died in Mansfield last year. From all this remarkable work, much more is sure to emerge, driven by the same restless, probing, experimental impulse. Mr. Everson, who teaches art at the University of Virginia in Charlottesville, is astoundingly prolific. He has so far produced 5 feature-length films and more than 70 short ones, as well as paintings, photographs and sculptures. It's easy to understand why the Whitney saw fit to give him a gallery of his own, albeit a small and out-of-the-way one. The time is not far off when he'll need an entire museum.

"More Than That: Films by Kevin Jerome Everson" remains through Sept. 18 at the Whitney Museum of American Art; (212) 570-3600, whitney.org.

http://www.nytimes.com/2011/08/19/arts/design/films-by-kevin-jerome-everson-at-the-whitney-museum.html?ref=design

Breathing New Life Into Earth: Evidence of Early Oxygen in the Oceans of Our Planet

Today, oxygen takes up a hefty portion of Earth's atmosphere: Life-sustaining O2 molecules make up 21 percent of the air we breathe. However, very early in Earth's history, O2 was a rare -- if not completely absent -- player in the turbulent mix of primordial gases. (Credit: © Andrejs Pidjass / Fotolia)

ScienceDaily (Aug. 17, 2011) — Today, oxygen takes up a hefty portion of Earth's atmosphere: Life-sustaining O_2 molecules make up 21 percent of the air we breathe. However, very early in Earth's history, O_2 was a rare -- if not completely absent -- player in the turbulent mix of primordial gases. It wasn't until the "Great Oxidation Event" (GOE), nearly 2.3 billion years ago, when oxygen made any measurable dent in the atmosphere, stimulating the evolution of air-breathing organisms and, ultimately, complex life as we know it today.

Now, new research from MIT suggests O_2 may have been made on Earth hundreds of millions of years before its debut in the atmosphere, keeping a low profile in "oxygen oases" in the oceans. The MIT researchers found evidence that tiny aerobic organisms may have evolved to survive on extremely low levels of the gas in these undersea oases.

In laboratory experiments, former MIT graduate student Jacob Waldbauer, working with Professor of Geobiology Roger Summons and Dianne Newman, formerly of MIT's Department of Biology and now at the California Institute of Technology, found that yeast -- an organism that can survive with or without oxygen -- is able to produce key oxygen-dependent compounds, even with only miniscule puffs of the gas.

The findings suggest that early ancestors of yeast could have been similarly resourceful, working with whatever small amounts of O_2 may have been circulating in the oceans before the gas was detectable in the atmosphere. The team published its findings last week in the *Proceedings of the National Academy of Sciences*.

"The time at which oxygen became an integral factor in cellular metabolism was a pivotal point in Earth history," Summons says. "The fact that you could have oxygen-dependent biosynthesis very early on in Earth's history has significant implications."

The group's results may help reconcile a debate within the earth sciences community: About a decade ago, geochemists encountered sedimentary rocks containing fossil steroids, an essential component of some organisms' cell membranes. Making a single molecule of a sterol, such as cholesterol, from scratch requires at

least 10 molecules of O_2; since the molecular fossils date back to 300 million years before the GOE, some have interpreted them as the earliest evidence of oxygen's presence on Earth. But because other evidence for the presence of oxygen in rocks of similar age is inconclusive, many geologists have questioned whether the fossilized steroids are indeed proof of early oxygen.

Waldbauer and colleagues suggest that perhaps O_2 was in fact present on Earth 300 million years before it spiked in the atmosphere -- just at extremely low concentrations that wouldn't have left much of a trace in the rock record. They reasoned that, even at such low levels, this O_2 may have been sufficient to feed aerobic, sterol-producing organisms.

To test their theory, they looked to modern yeast as a model. Yeast naturally uses O_2, in combination with sugars, to synthesize ergosterol, its primary sterol. Yeast can also grow without O_2, so long as a source of ergosterol is provided. To find the lowest level of O_2 yeast can consume, the team set up an experiment to identify the point at which yeast switches from anaerobic to aerobic activity.

Waldbauer grew yeast cells with a mixture of essential ingredients, including ergosterol as well as glucose labeled with carbon-13. They found that, without oxygen present, yeast happily took up sterol from the medium but made none from scratch. When Waldbauer pumped in tiny amounts of oxygen, a switch occurred, and yeast began using O_2 in combination with glucose to produce its own sterols. The presence of carbon-13 differentiates the biosynthesized sterol from that acquired from the growth medium.

The scientists found that yeast are able to make steroids using vanishingly small, nanomolar concentrations of O_2, supporting the theory that oxygen -- and its producers and consumers -- may have indeed been around long before the gas made an appearance in the atmosphere.

Waldbauer and Summons surmise that oxygen production and consumption may have occurred in the oceans for hundreds of millions of years before the atmosphere saw even a trace of the gas. They say that in all likelihood, cyanobacteria, blue-green algae living at the ocean surface, evolved the ability to produce O_2 via sunlight in a process known as oxygenic photosynthesis. But instead of building up in the oceans and then seeping into the atmosphere, O_2 may have been rapidly consumed by early aerobic organisms. Large oceanic and atmospheric sinks, such as iron and sulfide spewing out of subsea volcanoes, likely consumed whatever O_2 was left over.

"We know all kinds of biology happens without any O_2 at all," says Waldbauer, now a postdoc at Caltech. "But it's quite possible there was a vigorous cycle of O_2 happening in some places, and other places it might have been completely absent."

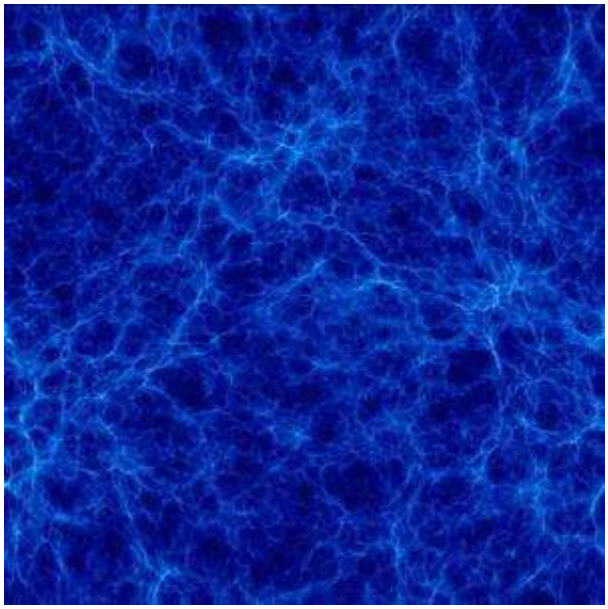
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by Massachusetts Institute of Technology. The original article was written by Jennifer Chu, MIT News Office.

Journal Reference:

1. J. R. Waldbauer, D. K. Newman, R. E. Summons. Microaerobic steroid biosynthesis and the molecular fossil record of Archean life. *Proceedings of the National Academy of Sciences*, 2011; DOI: 10.1073/pnas.1104160108

http://www.sciencedaily.com/releases/2011/08/110816112118.htm

Cosmological Evolution of Dark Matter Is Similar to That of Visible Matter



Visualization of DM distribution 800 millions years after the Big Bang. (Credit: The Marenostrum Numerical Cosmology Project)

ScienceDaily (Aug. 17, 2011) — Large cosmic structures made up of dark and normal matter evolve along the same lines -- this is one of the most important conclusions emerging from the latest computer simulations. The performed calculations mark the culmination of many years of work by a Polish, German and Russian team of astrophysicists and cosmologists.

High-resolution computer simulations prepared by a team of scientists from the Faculty of Physics, University of Warsaw (FUW), the Lebedev Physical Institute of the Russian Academy of Sciences and the Institute for Astrophysics in Potsdam made it possible to trace the evolution of large clouds of dark and normal matter that fill the Universe. The results confirm earlier assumptions regarding the basic features of dark matter, especially its distribution on cosmological scales.

For several decades, astronomers have been struggling to explain the motion of stars in galaxies and of galaxies in galaxy clusters. Measurements show that a typical galaxy must contain 10 to 50 times more invisible matter than normal one, and galaxy clusters must contain even up to 100 to 500 times more of the former. "It turns out that normal matter, which makes up our everyday world, is but a slight addition to dark matter. There is at least six times more of the latter in the Universe -- and nobody knows what it is. Discovering its nature is a thrilling experience," says Prof. Marek Demiański from the Faculty of Physics, University of Warsaw (FUW).

Currently, it is assumed that dark matter consists of exotic particles, not yet known to science, which barely, if at all, interact with electromagnetic radiation and other elementary particles known today. Scientists can observe dark matter only indirectly, by investigating the impact of its gravity on the motion of normal matter.

Given the significant amount of dark matter, it must have played a fundamental role in the formation of galaxies and their clusters. Scientists are, therefore, interested in the way in which dark matter is distributed across the Universe and in which the structures made up of it evolved over time. In order to answer these questions, one would need to observe galaxy clusters, the light of which travelled to Earth ten or more billion

years. Yet such distant object are difficult to detect. As a result, the amount of observational data is insufficient to allow for a statistical analysis.

Computer simulations prove useful in research into dark matter. They make it possible to observe the process of clustering of dark matter on large scales and its impact on the distribution of normal matter. By comparing the results obtained in this way with observational data, it is possible to assess the extent to which the scientists' assumptions regarding the properties of dark matter coincide with the reality.

In the early periods after the Big Bang both dark and normal matter were more or less equally distributed. In contrast to normal one, dark matter does not interact with electromagnetic radiation, which filled the Universe shortly after the Big Bang and thus could succumb more quickly to the impact of its own gravity. Slight distortions in the distribution of dark matter began to contract gravitationally, attracting dark matter, and in later periods also normal one. The simulations by Polish, German and Russian group of scientists mirror the process.

During the simulations the scientists analyzed the behaviour of about a billion point objects distributed in a cube with side length of several hundred million light years. As time went on, the original cube was expanded along with the "ballooning" Universe. About a billion points were evenly distributed in the cube -- the limitation on their number being the computing power of today's computers. Each point in the simulation had a mass of hundred million times the mass of the Sun. Characteristics of dark matter were assigned to most of the points. Subsequently, the scientists analyzed the way in which the distribution of the points was changing over time under the influence of gravity.

One of the most important conclusions emerging from the performed simulations is the confirmation of the self-similarity of the process of evolution of the structure of dark and normal matter on large cosmic scales. Which means that if we examine a cube four billion years after the Big Bang and later compare it with a ten-billion-year-old cube, then, after matching the dimensions of both cubes, it turns out that the structures inside them made up of dark and normal matter look virtually the same.

"This similarity between the processes of evolution of both types of matter makes it possible to recreate the distribution of dark matter on the basis of the distribution of normal matter. Our simulations have confirmed this effect and we can now say with greater certainty that we are able to gain insight into the invisible world of dark matter by observing the motion of galaxy clusters," concludes Prof. Demiański.

The results of the computer simulations of the distribution of dark and normal matter were published in the *Monthly Notices of the Royal Astronomical Society* and presented on the international conference JENAM 2011 European Week of Astronomy and Space Science on July 4-8 in Saint Petersburg, Russia.

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

Journal Reference:

1. M. Demiański, A. Doroshkevich, S. Pilipenko, S. Gottlöber. Simulated evolution of the dark matter large-scale structure of the Universe. *Monthly Notices of the Royal Astronomical Society*, 2011; 414 (3): 1813 DOI: 10.1111/j.1365-2966.2011.18265.x

http://www.sciencedaily.com/releases/2011/07/110721102021.htm

Major Breakthrough On How Viruses Infect Plants

Tobacco plants affected by the virus and resistant to it. (Credit: Carl Davies CSIRO)

ScienceDaily (Aug. 17, 2011) — CSIRO plant scientists have shed light on a problem that has puzzled researchers since the first virus was discovered in 1892 -- how exactly do they cause disease?

In a major breakthrough that helps us better understand how viruses cause diseases in plants -- and potentially in animals and humans -- Dr Ming-Bo Wang and Neil Smith of CSIRO Plant Industry have revealed a genetic mechanism that enables viral organisms to infect hosts and cause diseases.

"Cucumber Mosaic Virus (CMV) is a common, destructive virus that affects a wide range of food crops and ornamental plants," Dr Wang said.

"What we found was that CMV, accompanied by a special type of viral particle called a 'satellite', causes its distinctive yellowing symptoms in plants by slicing a gene that makes chlorophyll, the green pigment in leaves. By preventing the production of chlorophyll, the virus causes the leaves to become partially or entirely yellowed which dramatically affects growth and productivity."

Importantly, Dr Wang and Mr Smith determined the exact gene affected by this virus -- a gene called CHL1.

"Pinpointing this gene represents a major step forward in understanding exactly how some viruses cause disease symptoms in susceptible organisms," Dr Wang said.

Until recently, scientists did not fully understand why viruses only affected a small range of host organisms. This discovery shows that the accompanying satellite gene of CMV must directly match the host plant's genes to cause the yellowing disease.

When the viral satellite's genes match the host plant's genes, the satellite genes 'lock' onto and slice the host's genes, preventing the host from forming green chlorophyll pigment.

"Think of it as like doing up a zipper on your jacket -- two opposing but different sections have to come together for it to work," Dr Wang said.

"So one half of the 'zipper' genes come from the virus and the other half of the genes from the host, and when they match up the virus causes disease."

This finding means researchers can focus on finding genes in viruses that match known genetic sequences in plants, and this can help to reveal the cause of diseases by other viruses.

Knowing how CMV causes symptoms, Dr Wang and Mr Smith also experimented to see if they could block the viral disease in plants. They created specially altered plants with an extra copy of the chlorophyll-producing gene. This gene had been changed so that it no longer matched the viral gene, allowing the plants to produce the green chlorophyll pigment.

Remarkably, this small change in genetic makeup prevented the plants from becoming yellow and diseased but did not change any other aspects of the plants' growth, habit or form.

This research was funded by CSIRO and the Australian Research Council (ARC) and will be presented at the International Botanical Congress in Melbourne, 23-30 July 2011.

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

http://www.sciencedaily.com/releases/2011/08/110810093833.htm

There Can Be Beauty in Barriers

By CAROL KINO

Lee Marks Fine Art

"Terraces," a photo by Mariana Cook taken in Ollantaytambo, Peru.

SOMETIMES inspiration arrives when you least expect it. That's certainly true for "Stone Walls: Personal Boundaries," the latest book by the photographer Mariana Cook. For eight years Ms. Cook took her two medium-format cameras and a tripod to places as far afield as Malta, Peru and the Aran Islands, searching for dry stone walls built without mortar but with plenty of patience and ingenuity. (An interactive feature on five photographs from the book is here.)

"It was their beauty that kept me going," Ms. Cook said. "You've got to be a little nuts to go all over the world, tromping around fields looking for walls."

The quest began on her own property on Martha's Vineyard, and expanded out from there. As she traveled New England in search of more walls, her interest in them only grew.

"Seeing the juxtaposition of two or three stones together could just be so beautiful," she said. "Their intricacies were remarkable and endless."

Because the practice of building them is on the wane worldwide — a direct result of the decline in family farms — Ms. Cook is donating a portion of profits from the book to the nonprofit Dry Stone Conservancy in Lexington, Ky., which is dedicated to preserving existing walls and revivifying the craft.

At first glance this subject seems something of a departure for Ms. Cook, 56, best known for books of portraits and family relationship pictures, like "Fathers and Daughters" (1994) and "Mothers and Sons" (1996). In 1996, while working on her 2000 book, "Couples," she also made a portrait of a young Barack and Michele Obama, which was finally published just before he was inaugurated.

"My father was a psychoanalyst, and I was always interested in what beneath the surface made a person who they were," Ms. Cook said.

Early on, however, she received a strong grounding in landscape photography as the last protégée of Ansel Adams, with whom she studied from 1978, after graduating from college, until his death in 1984. "Ansel taught me my craft," she said.

Besides, Ms. Cook also says that a stone wall says a lot about the psychology of the person who made it. If you encounter a wall made with little stones shoring up the big ones, she noted, "you can tell that's a lazy person who didn't want to take the time and trouble to fit two big stones together." But when it's a well-made wall, "the stones are generally of a good size, and they rest on each other comfortably," she said. "They look like they belong together."

http://www.nytimes.com/2011/08/14/arts/design/stone-walls-personal-boundaries-by-mariana-cook.html?ref=design

Growth of Cities Endangers Global Environment, According to New Analysis

Manhattan at sunset. (Credit: © Ilja Mašík / Fotolia)

ScienceDaily (Aug. 20, 2011) — The explosive growth of cities worldwide over the next two decades poses significant risks to people and the global environment, according to a meta-analysis published August 19 in PLoS ONE.

Researchers from Yale, Arizona State, Texas A&M and Stanford predict that by 2030 urban areas will expand by 590,000 square miles -- nearly the size of Mongolia -- to accommodate the needs of 1.47 billion more people living in urban areas.

"It is likely that these cities are going to be developed in places that are the most biologically diverse," said Karen Seto, the study's lead author and associate professor in the urban environment at the Yale School of Forestry & Environmental Studies. "They're going to be growing and expanding into forests, biological hotspots, savannas, coastlines -- sensitive and vulnerable places."

Urban areas, they found, have been expanding more rapidly along coasts. "Of all the places for cities to grow, coasts are the most vulnerable. People and infrastructure are at risk to flooding, tsunamis, hurricanes and other environmental disasters," said Seto.

The study provides the first estimate of how fast urban areas globally are growing and how fast they may grow in the future. "We know a lot about global patterns of urban population growth, but we know significantly less about how urban areas are changing," she said. "Changes in land cover associated with urbanization drive many environmental changes, from habitat loss and agricultural land conversion to changes in local and regional climate."

The researchers examined peer-reviewed studies that used satellite data to map urban growth and found that from 1970 to 2000 the world's urban footprint had grown by at least 22,400 square miles -- half the size of Ohio.

"This number is enormous, but, in actuality, urban land expansion has been far greater than what our analysis shows because we only looked at published studies that used satellite data," said Seto. "We found that 48 of the most populated urban areas have been studied using satellite data, with findings in peer-reviewed journals. This means that we're not tracking the physical expansion of more than half of the world's largest cities."

Half of urban land expansion in China is driven by a rising middle class, whereas the size of cities in India and Africa is driven primarily by population growth. "Rising incomes translate into rising demand for bigger homes and more land for urban development, which has big implications for biodiversity conservation, loss of carbon sinks and energy use."

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

Journal Reference:

1. Karen C. Seto, Michail Fragkias, Burak Güneralp, Michael K. Reilly. A Meta-Analysis of Global Urban Land Expansion. *PLoS ONE*, 2011; 6 (8): e23777 DOI: 10.1371/journal.pone.0023777

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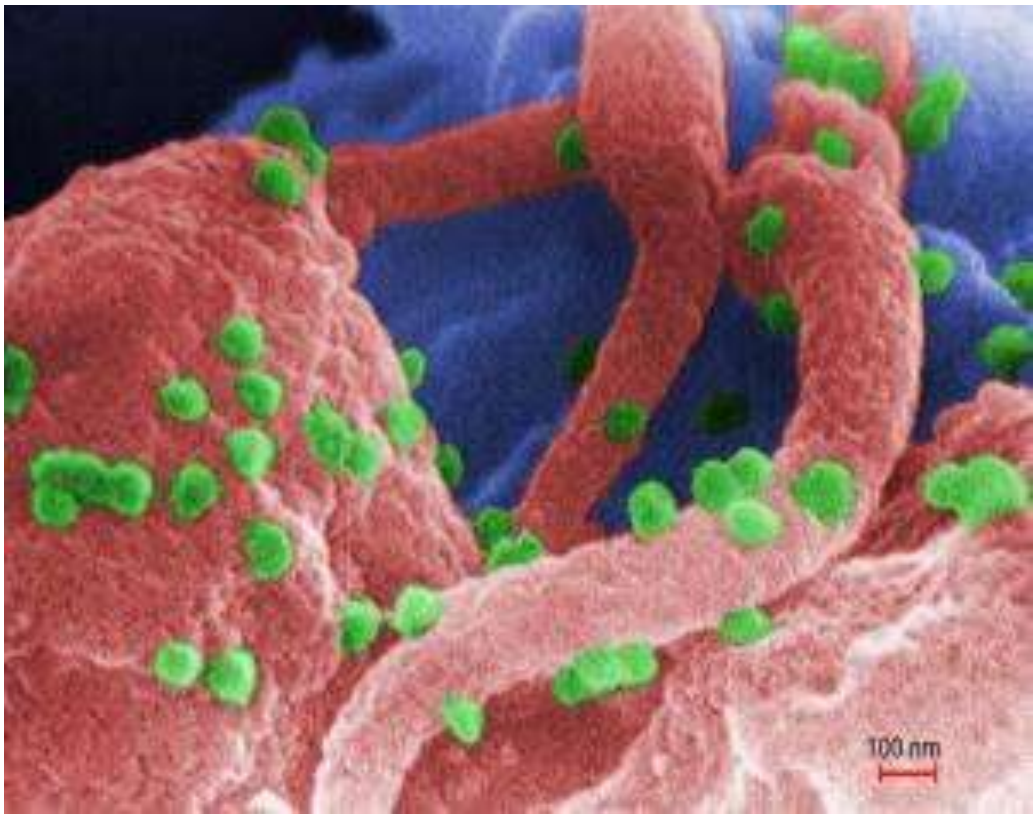
AIDS Researchers Isolate New Potent and Broadly Effective Antibodies Against HIV



This scanning electron micrograph revealed the presence of the human immunodeficiency virus (HIV-1), (spherical in appearance), which had been co-cultivated with human lymphocytes. Note the lymphocyte in the lower left, and some of its extended pseudopodia. HIV-1 virions can be seen on the surface of this lymphocyte. (Credit: CDC/C. Goldsmith, P. Feorino, E. L. Palmer, W. R. McManus)

ScienceDaily (Aug. 17, 2011) — A team of researchers at and associated with the International AIDS Vaccine Initiative (IAVI), The Scripps Research Institute, the biotechnology company Theraclone Sciences and Monogram Biosciences Inc., a LabCorp company, report in the current issue of *Nature* the isolation of 17 novel antibodies capable of neutralizing a broad spectrum of variants of HIV, the virus that causes AIDS.

The new antibodies, large protein molecules that bind to pathogens and flag them for destruction, were isolated from blood serum samples collected in a continuing global search for broadly neutralizing antibodies (bNAbs) launched by IAVI. They should provide researchers with a new set of targets for the design of vaccine candidates that can elicit similar antibodies to protect people from contracting HIV. Some of the bNAbs blocked HIV infection of cells as much as 10 to 100 times as potently as previously discovered bNAbs.

"Most antiviral vaccines depend on stimulating the antibody response to work effectively," said Dennis Burton, a professor of immunology and microbial science and director of the IAVI Neutralizing Antibody Center at The Scripps Research Institute in La Jolla, Calif. Professor Burton, one of the senior authors of the study, is also a member of the Ragon Institute, in Cambridge, Mass. "Because of HIV's remarkable variability, an effective HIV vaccine will probably have to elicit broadly neutralizing antibodies. This is why we expect that these new antibodies will prove to be valuable assets to the field of AIDS vaccine research."

Only a minority of people who are HIV-positive begin to produce bNAbs after several years of infection. Animal studies suggest that such antibodies could block HIV infection if they were elicited by a preventive vaccine. Researchers prize bNAbs because their structural and biochemical analysis can reveal how to achieve a preventive vaccine. Specifically, scientists expect that they can use information about how bNAbs bind to HIV to construct immunogens -- the active ingredients of vaccines -- that elicit similar antibodies. The potency of bNAbs matter because a highly potent antibody could confer such protection at relatively low levels.

"Solving the neutralizing antibody problem is perhaps the greatest challenge facing the field today," said IAVI's chief scientific officer, Wayne Koff. "IAVI concluded many years ago that unlocking the information stored in bNAbs was going to be essential to the fulfillment of our mission -- ensuring the design and development of broadly effective AIDS vaccines. This is why we support several laboratories around the world that are designing novel vaccine candidates on the basis of what we're learning from such antibodies. We have no doubt that these new bNAbs will contribute a great deal to our own immunogen design efforts and, we hope, those of other researchers working on AIDS vaccines."

In that regard, the new bNAbs are encouraging. Many of them bind hitherto unknown molecular structures, or epitopes, on the surface of HIV. This means that they could significantly broaden the target options researchers have in designing vaccines to elicit similar antibodies.

How the antibodies were discovered

The 17 new bNAbs described in the current Nature report were isolated from four HIV-positive individuals. The effort, sponsored by IAVI, is unprecedented in scale and distinguished by its emphasis on identifying antibodies that neutralize subtypes of HIV circulating primarily in developing countries. It had previously yielded three potent bNAbs, two of which, PG9 and PG16, were isolated by this research team in 2009 and described in the journal Science. Another bNAb was subsequently isolated from these samples by researchers at the Vaccine Research Center of the National Institutes of Health, who have also discovered a set of bNAbs from separate blood samples using an entirely different approach.

Both the previous and current studies used Theraclone Science's highly sensitive I-STAR™ technology to isolate the antibodies. The new crop of bNAbs, like PG9 and PG16, was rescued from cell cultures derived from single antibody-producing B cells used for antibody discovery and development. Theraclone Sciences Executive Chair and Interim CEO, Steven Gillis commented, "We're delighted that I-STAR has provided essential support in identifying bNAbs that will contribute to advancing AIDS vaccine development. In this project, and in our own infectious disease and cancer programs, the I-STAR platform continues to demonstrate a remarkably powerful ability to isolate rare antibodies with unique properties. Theraclone values these collaborative opportunities in which I-STAR can be used to help improve treatment for critical diseases."

Monogram Biosciences, which also participated in the discovery of PG9 and PG16, conducted the neutralization assays essential to isolating the new bNAbs. The serum samples from which they were isolated represent the top 1% of all such samples gathered by IAVI and its partners, in terms of the number of HIV variants they neutralize and the potency with which they do so.

"Monogram has developed a highly skilled scientific team capable of taking on a variety of biomedical challenges," said Chris Petropoulos, Vice President, Laboratory Corporation of America Holdings, Research and Development, Monogram Biosciences. "Their expertise and innovation has been invaluable to the discovery of these new antibodies. This research illustrates the important role different sectors of the research and health care community can play in supporting global health initiatives."

The analysis of the new antibodies also hints at how future vaccines ought to be formulated to maximize their effectiveness. On the basis of their analyses, the authors of the report conclude that AIDS vaccine candidates that seek to effectively harness the antibody response should probably attempt to elicit certain combinations of bNAbs if they are to provide truly comprehensive protection from HIV.

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

Journal Reference:

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http://www.sciencedaily.com/releases/2011/08/110817130959.htm

Key Mechanism That Regulates Shape and Growth of Plants Discovered

Arabidopsis. Researchers have discovered a key mechanism that -- much like a construction site foreperson -- controls the direction of plant growth as well as the physical properties of the biopolymers that plants produce. (Credit: © Vasiliy Koval / Fotolia)

ScienceDaily (Aug. 16, 2011) — UBC researchers have discovered a key mechanism that -- much like a construction site foreperson -- controls the direction of plant growth as well as the physical properties of the biopolymers that plants produce. The finding is a major clue in a 50-year-long quest to explain how plants coordinate the behaviour of millions of cells as they grow upward to compete for light, penetrate soil to obtain nutrients and water, and even open petals to flower.

"We've known for decades that structures in plants called microtubules act as scaffolding to define the direction of cell expansion," says Professor Geoffrey Wasteneys, a UBC botanist and Canada Research Chair in Plant Cell Biology.

"These are tiny multipurpose cylinders that grow, shrink and self-organize to transport cargo, capture and position large structures such as chromosomes, and establish the shape of cells. But we haven't been able to determine how these tiny microtubules are organized into scaffolds in the first place."

An interdisciplinary team of plant cell biologists and mathematicians led by Wasteneys discovered that the inherent geometry of the cell itself plays an important role in the self-organization of microtubules into parallel arrays that guide cell growth and division. They also identified that a protein called CLASP plays a key role as a foreperson, modulating the geometric constraints of the cell.

Their findings will be published in the August 16 issue of the journal *Nature Communications.*

The research team used a specialized microscope that collects 3D images of plant components genetically engineered to fluoresce when irradiated with specially filtered light. They observed a striking difference in the way microtubules were arranged in normal plants compared to those of a dwarf mutant that fails to produce CLASP.

"Paradoxically, the microtubules appeared to be better organized in the severely stunted mutant plants than they were in the non-mutant plants," says Chris Ambrose, the post-doctoral fellow in Wasteneys' lab whose observations led to the discovery. "By examining how microtubules behave at the sharp edges between adjacent cell faces, we noticed that in the mutant, microtubules would grow into the edges and then undergo catastrophic disassembly. In the non-mutant plants containing the CLASP protein, microtubules would easily bend through 90 degrees and continue growing on the adjacent cell face upon encountering an edge."

Ambrose and Wasteneys then joined forces with UBC mathematicians Eric Cytrynbaum and Jun Allard to run three-dimensional computer simulations to test the ideas that emerged from imaging the living plant cells.

The researchers found that the simulations, which typically take about a day to run on a super computer, closely recapitulated the microtubule patterns observed in living cells.

"Simulation after simulation showed us that microtubules would form parallel arrays in the same patterns seen in living cells," says Allard, now a post-doctoral researcher at the University of California, Davis. "We confirmed that the self-organization depends on the extrinsic cues from the cellular geometry, and that the presence of the CLASP protein along select edges modified the pattern dramatically."

The finding may also be relevant to the burgeoning interest in stem cell biology in the biomedical research field. "Microtubules and the CLASP protein are common to all cell types in plants animals, fungi and many unicellular organisms," says Wasteneys. "So what we find out about their behaviour in plant cells is relevant to understanding their function in cells types as diverse as neurons and disease-causing protozoans."

The research was funded by the Natural Sciences and Engineering Research Council of Canada, the Canadian Institutes of Health Research, and the Canada Foundation for Innovation.

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

Journal Reference:

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Speaking and Understanding Speech Share the Same Parts of the Brain

New research finds that speaking and understanding speech share the same parts of the brain. (Credit: © Artsem Martysiuk / Fotolia)

ScienceDaily (Aug. 16, 2011) — The brain has two big tasks related to speech: making it and understanding it. Psychologists and others who study the brain have debated whether these are really two separate tasks or whether they both use the same regions of the brain. Now, a new study, published in the August issue of *Psychological Science*, a journal of the Association for Psychological Science, finds that speaking and understanding speech share the same parts of the brain, with one difference: we don't need the brain regions that control the movements of lips, teeth, and so on to understand speech.

Most studies of how speech works in the brain focuses on comprehension. That's mostly because it's easier to image the brains of people who are listening quietly; talking makes the head move, which is a problem when you're measuring the brain. But now, the Donders Institute at the Radboud University Nijmegen, where the study was conducted, has developed technology that allows recording from a moving brain.

Laura Menenti, a Postdoctoral Research Associate at the University of Glasgow, co-wrote the paper along with Peter Hagoort of Radboud University Nijmegen and the Max Planck Institute for Psycholinguistics, Sarah Gierhan and Katrien Segaert. Menenti was initially interested in how the brain produces grammatical sentences and wanted to track the process of producing a sentence in its entirety; looking not only at its grammatical structure but also at its meaning. "What made this particularly exciting to us was that no one had managed to perform such a study before, meaning that we could explore an almost completely new topic," says Menenti.

The authors used functional MRI technology to measure brain activity in people who were either listening to sentences or speaking sentences. The other problem with measuring brain activity in people who are speaking is that you have to get them to say the right kind of sentence. The authors accomplished this with a picture of an action -- a man strangling a woman, say -- with one person colored green and one colored red to indicate their order in the sentence. This prompted people to say either "The man is strangling the woman" or "The woman is strangled by the man." (The experiments were all carried out in Dutch.)

From this, the researchers were able to tell where in the brain three different speech tasks (computing meaning, coming up with the words, and building a grammatical sentence) -- were taking place. They found that the same areas were activated for each of these tasks in people who were speaking and people who were listening to sentences. However, although some studies have suggested that while people are listening to speech, they silently articulate the words in order to understand them, the authors found no involvement of motor regions when people were listening.

According to Menenti, though the study was largely designed to answer a specific theoretical question, it also points towards some useful avenues for treatment of people with language-related problems. It suggests that while it sometimes seems that people with comprehension problems may have intact production, and vice versa, this may not necessarily be the case. According to Menenti, "Our data suggest that these problems would be expected to always at least partly coincide. On the other, our data confirm the idea that many different processes in the language system, such as understanding meaning or grammar, can at least partly, be damaged independently of each other."

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

Journal Reference:

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Possibility of Temporarily Reversing Aging in the Immune System

Researchers have discovered a new mechanism controlling aging in white blood cells. The research opens up the possibility of temporarily reversing the effects of aging on immunity and could, in the future, allow for the short-term boosting of the immune systems of older people. (Credit: © nyul / Fotolia)

ScienceDaily (Aug. 16, 2011) — Researchers have discovered a new mechanism controlling aging in white blood cells. The research, published in the September issue of the *Journal of Immunology*, opens up the possibility of temporarily reversing the effects of aging on immunity and could, in the future, allow for the short-term boosting of the immune systems of older people.

Weakened immunity is a serious issue for older people. Because our immune systems become less effective as we age we suffer from more infections and these are often more severe. This takes a serious toll on health and quality of life.

Professor Arne Akbar of UCL (University College London), who led this research, explains "Our immune systems get progressively weaker as we age because each time we recover from an infection a proportion of our white blood cells become deactivated. This is an important process that has probably evolved to prevent certain cancers, but as the proportion of inactive cells builds up over time our defenses become weakened.

"What this research shows is that some of these cells are being actively switched off in our bodies by a mechanism which hadn't been identified before as important in aging in the immune system. Whilst we wouldn't want to reactivate these cells permanently, we have an idea now of how to wake them from their slumber temporarily, just to give the immune system a little boost."

Until now, aging in immune cells was thought to be largely determined by the length of special caps on the ends of our DNA. These caps, called telomeres, get shorter each time a white blood cell multiplies until, when they get too short, the cell gets permanently deactivated. This means that our immune cells have a built-in lifespan of effectiveness and, as we live longer, this no longer long enough to provide us protection into old age.

However when Professor Akbar's team took some blood samples and looked closely at the white blood cells they saw that some were inactive and yet had long telomeres. This told the researchers that there must be another mechanism in the immune system causing cells to become deactivated that was independent of telomere length.

Professor Akbar continues "Finding that these inactive cells had long telomeres was really exciting as it meant that they might not be permanently deactivated. It was like a football manager finding out that some star players who everyone thought had retired for good could be coaxed back to play in one last important game."

When the researchers blocked this newly identified pathway in the lab they found that the white blood cells appeared to be reactivated. Medicines which block this pathway are already being developed and tested for use in other treatments so the next step in this research is to explore further whether white blood cells could be reactivated in older people, and what benefits this could bring.

Professor Akbar continues "This research opens up the exciting possibility of giving older people's immune systems a temporary boost to help them fight off infections, but this is not a fountain of eternal youth. It is perfectly normal for our immune systems to become less effective and there are good evolutionary reasons for this. We're a long way from having enough understanding of aging to consider permanently rejuvenating white blood cells, if it is even possible."

Professor Douglas Kell, Chief Executive of the Biotechnology and Biological Sciences Research Council, said: "This is a fantastic example of the value of deepening our understanding of fundamental cell biology. This work has discovered a new and unforeseen process controlling how our immune systems change as we get older. Also, by exploring in detail how our cells work, it has opened up the prospect of helping older people's immune systems using medicines that are already being tested and developed. By increasing the incidence and severity of infection, weakened immunity seriously damages the health and quality of life of older people so this research is very valuable."

This research was funded by the Biotechnology and Biological Sciences Research Council (BBSRC.

story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by Biotechnology and Biological Sciences Research Council.

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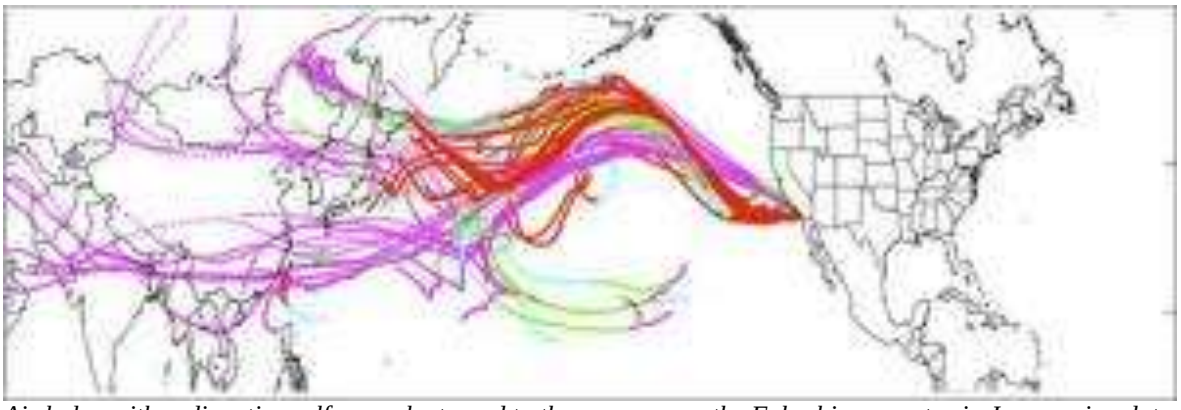
http://www.sciencedaily.com/releases/2011/08/110816111921.htm

Measurements Reveal Extent of Leakage from Japan's Damaged Fukushima Reactor



Air laden with radioactive sulfur can be traced to the source near the Fukushima reactor in Japan using data collected by NOAA. (Credit: Gerardo Dominguez)

ScienceDaily (Aug. 16, 2011) — Atmospheric chemists at the University of California, San Diego, report the first quantitative measurement of the amount of radiation leaked from the damaged nuclear reactor in Fukushima, Japan, following the devastating earthquake and tsunami earlier this year.

Their estimate, reported this week in the early, online edition of the *Proceedings of the National Academy of Sciences,* is based on a signal sent across the Pacific Ocean when operators of the damaged reactor had to resort to cooling overheated fuel with seawater.

"In any disaster, there's always a lot to be learned by analysis of what happened," said senior author Mark Thiemens, Dean of the Division of Physical Sciences at UC San Diego. "We were able to say how many neutrons were leaking out of that core when it was exposed."

On March 28, 2011, 15 days after operators began pumping seawater into the damaged reactors and pools holding spent fuel, Thiemens' group observed an unprecedented spike in the amount of radioactive sulfur in the air in La Jolla, California. They recognized that the signal came from the crippled power plant.

Neutrons and other products of the nuclear reaction leak from fuel rods when they melt. Seawater pumped into the reactor absorbed those neutrons, which collided with chloride ions in the saltwater. Each collision knocked a proton out of the nucleus of a chloride atom, transforming the atom to a radioactive form of sulfur.

When the water hit the hot reactors, nearly all of it vaporized into steam. To prevent explosions of the accumulating hydrogen, operators vented the steam, along with the radioactive sulfur, into the atmosphere.

In air, sulfur reacts with oxygen to form sulfur dioxide gas and then sulfate particles. Both blew across the Pacific Ocean on prevailing westerly winds to an instrument at the end of the pier at UC San Diego's Scripps Institution of Oceanography where Thiemens' group continuously monitors atmospheric sulfur.

Using a model based on NOAA's observations of atmospheric conditions the team determined the path air took on its way to the pier over the preceding 10 days and found that it led back to Fukushima.

Then they calculated how much radiation must have been released. "You know how much seawater they used, how far neutrons will penetrate into the seawater and the size of the chloride ion. From that you can calculate

how many neutrons must have reacted with chlorine to make radioactive sulfur," said Antra Priyadarshi, a post-doctoral researcher in Thiemens' lab and first author of the paper.

After accounting for losses along the way as the sulfate particles fell into the ocean, decayed, or eddied away from the stream of air heading toward California, the researchers calculated that 400 billion neutrons were released per square meter surface of the cooling pools, between March 13, when the seawater pumping operation began, and March 20, 2011.

The trace levels of radiation that reached the California coast never posed a threat to human health. "Although the spike that we measured was very high compared to background levels of radioactive sulfur, the absolute amount of radiation that reached California was small. The levels we recorded aren't a concern for human health. In fact, it took sensitive instruments, measuring radioactive decay for hours after lengthy collection of the particles, to precisely measure the amount of radiation," Thiemens said.

Concentrations a kilometer or so above the ocean near Fukushima must have been about 365 times higher than natural levels to account for the levels they observed in California.

The radioactive sulfur that Thiemens and his team observed must have been produced by partially melted nuclear fuel in the reactors or storage ponds. Although cosmic rays can produce radioactive sulfur in the upper atmosphere, that rarely mixes down into the layer of air just above the ocean, where these measurements were made.

Over a four day period ending on March 28th, they measured 1501 atoms of radioactive sulfur in sulfate particles per cubic meter of air, the highest they've ever seen in more than two years of recordings at the site.

Even intrusions from the stratosphere -- rare events that bring naturally produced radioactive sulfur toward Earth's surface -- have produced spikes of only 950 atoms per cubic meter of air at this site.

The nuclear reaction within the cooling seawater marked sulfur that originated in a specific place for a discrete period of time. That allowed researchers to time the transformation of sulfur to sulfur dioxide gas and sulfate particles, and measure their transport across the ocean, both important factors for understanding how sulfate pollutants contribute to climate change.

"We've really used the injection of a radioactive element to an environment to be a tracer of a very important process in nature for which there are some big gaps in understanding," Thiemens said.The event also created a pulse of labeled sulfur that can be traced in the streams and soils in Japan, to better understand how this element cycles through the environment, work that Thiemens and colleagues in Japan have already begun.

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

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Biologists Confirm Sunflower Domesticated in Eastern North America

Sunflowers. New genetic evidence confirms the eastern United States as the single geographic domestication site of modern sunflowers. (Credit: © AlexeyE30 / Fotolia)

ScienceDaily (Aug. 16, 2011) — New genetic evidence presented by a team led by Indiana University biology doctoral graduate Benjamin Blackman confirms what is now the eastern United States as the single geographic domestication site of modern sunflowers. Co-authors on the findings published this week in *Proceedings of the National Academy of Sciences* include Blackman's advisor, IU Distinguished Professor of Biology Loren H. Rieseberg, and four others from Rieseberg's lab, as well as collaborators from Universidad Nacional Autonoma de Mexico and the University of Cincinnati.

Through a comprehensive examination of the geographic diversity in three recently identified early domestication genes of *Helianthus annuus*, the researchers also reported finding no DNA evidence to support suggestions based on archaeological evidence that a second, independent domestication event had occurred in what is now Mexico.

"Our results affirm that the eastern United States was an independent center of plant domestication and that all known living cultivated sunflowers shared a common origin there," Blackman said.

Controversy over the domestication of *H. annuus* began when sunflower seeds were found at pre-Columbian archaeological sites. It was proposed that, along with being domesticated in eastern North America, an independent sunflower domestication occurred in Mexico. Alternatively, sunflower may have been dispersed from eastern North America into Mexico through trade routes established before Spanish colonization.

This new work confirms domestication took place in eastern North America, probably in the Mississippi River Valley in the region of present day Arkansas.

The team analyzed the sequence diversity of three genes -- c4973, HaFT1, and HaGA2ox -- that had been identified as candidates for domestication genes, as well as the diversity of 12 neutral markers, and identified patterns of diversity in Mexican domesticated and wild sunflowers consistent with all other domesticated varieties known to have originated from an eastern North American domestication site. The study looked at 60 sunflower populations from the U.S. and Canada and 31 from Mexico.

"Even though we made extensive new collections of wild and cultivated sunflowers native to Mexico that for the first time provided us with a powerful sample to test for a second origin, our results from multiple types of genetic data found strong evidence for just a single origin," Blackman said.

The analysis of hereditary molecular differences in the three sunflower genes shown to have experienced selective sweeps -- the loss or lowering of variation in DNA sequences due to artificial or natural selection -- confirmed that domesticated sunflowers grown in Mexico today are descended from the same cultivated genetic lineage as eastern North America domesticated sunflowers. All of those varieties, whether from Mexico or North America, carried sequences diagnostic for cultivation at the domestication at these loci, and genetic ancestry inferred from neutral markers scattered throughout the genome independently and unambiguously confirmed the same result.

A few qualifications remain, as the team could have missed finding a modern Mexican domesticated version descended from an independent Mexican lineage. There may have also been an ancient Mexican lineage that has since become extinct and for which no modern germplasm has survived. Some scientists have speculated that extinction could have been facilitated by the proposed role colonial Spanish Christians may have taken in eradicating sunflower as an important religious symbol to the solar-worshipping Aztecs, or recently by the substantial influx of seed imports made possible by the North American Free Trade Agreement.

"Although current archaeological finds indicate that ancient Mesoamericans cultivated sunflower before Spanish colonists arrived in the New World, more discoveries are needed to understand where and how quickly sunflower crop development spread in Mesoamerica and eastern North America," Blackman added.

Further insights will come, he said, not only from new archaeological finds but also from new DNA sequencing technologies capable of obtaining data from thousands of genes from these ancient samples. Such advances would deepen understanding of how nascent sunflower cultivars were related to each other and when newly identified domestication alleles spread throughout eastern North American and Mexico.

Blackman noted the findings had special significance for the researchers with connections to the IU College of Arts and Sciences' Department of Biology, as the department's late distinguished professor emeritus Charles Heiser, a pioneering authority on sunflowers, had argued strongly before his death in 2010 for the single-domestication scenario.

Additional co-authors on the paper included Robert Bye of the Universidad Nacional Autonoma de Mexico, and David Lentz, University of Cincinnati. Blackman is currently a post-doctoral scholar at Duke University, where co-author David Rasmussen is a graduate student. Co-author Harry Luton is a research assistant with Rieseberg at IU and Moira Scascitelli and Nolan Kane are now post-docs at University of British Columbia, where Rieseberg holds a dual appointment as a professor of botany. Blackman, Rasmussen, Scascitelli and Kane have all been members of Rieseberg's IU Bloomington lab.

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

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E. Coli, Salmonella May Lurk in Unwashable Places in Produce

Amanda Deering and Robert Pruitt found that foodborne pathogens can live inside plant tissues. (Credit: Purdue Agricultural Communication photo/Tom Campbell)

ScienceDaily (Aug. 15, 2011) — Sanitizing the outside of produce may not be enough to remove harmful food pathogens, according to a Purdue University study that demonstrated that Salmonella and *E. coli* can live inside plant tissues.

E. coli 0157:H7 was present in tissues of mung bean sprouts and Salmonella in peanut seedlings after the plants' seeds were contaminated with the pathogens prior to planting. Amanda Deering, a postdoctoral researcher in food science, said seeds could be contaminated in such a manner before or after planting through tainted soil or water.

"The pathogens were in every major tissue, including the tissue that transports nutrients in plants," said Deering, whose results were published in separate papers in the *Journal of Food Protection* and Food Research International.

Deering and Robert Pruitt, a professor of botany and plant pathology, said finding pathogens inside plants has been challenging because tests require slicing off pieces of the plants, which can move the bacteria from the outside to the inside or vice versa. It becomes difficult to know where a pathogen might have been before the plant was cut.

"The results are often imprecise because the methods allow bacteria to move," said Pruitt, a co-author of the findings.

Deering used a fixative to freeze the location of the bacteria in the plant tissues before slicing samples. Antibodies labeled with fluorescent dye were used to detect the pathogens, a process called immunocytochemistry.

"This shows us as close to what was in the plant when it was living as possible," Deering said. "The number of bacteria increased and persisted at a high level for at least 12 days, the length of the studies."

Deering said she was able to count hundreds of bacteria in almost every type of tissue.

Proper sanitization would eliminate Salmonella and *E. coli* from the surface of foods, but not inner tissues, Deering and Pruitt said. Cooking those foods to temperatures known to kill the pathogens would eliminate them from inner tissues.

Deering and Pruitt will continue to study the pathogens to determine how they survive inside plant tissues and possible ways to eliminate them. The U.S. Department of Agriculture's Agricultural Research Service funded their work.

Story Source:
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http://www.sciencedaily.com/releases/2011/08/110815152049.htm

A Spectacular Spiral in Leo

This picture of the nearby galaxy NGC 3521 was taken using the FORS1 instrument on ESO's Very Large Telescope, at the Paranal Observatory in Chile. The large spiral galaxy lies in the constellation of Leo (The Lion), and is only 35 million light-years distant. This picture was created from exposures taken through three different filters that passed blue light, yellow/green light, and near-infrared light. These are shown in this picture as blue, green, and red, respectively. (Credit: ESO/O. Maliy)

ScienceDaily (Aug. 15, 2011) — This new picture from ESO's Very Large Telescope shows NGC 3521, a spiral galaxy located about 35 million light years away in the constellation of Leo (The Lion). Spanning about 50,000 light-years, this spectacular object has a bright and compact nucleus, surrounded by richly detailed spiral structure.

The most distinctive features of the bright galaxy NGC 3521 are its long spiral arms that are dotted with star-forming regions and interspersed with veins of dust. The arms are rather irregular and patchy, making NGC 3521 a typical example of a flocculent spiral galaxy. These galaxies have "fluffy" spiral arms that contrast with the sweeping arms of grand-design spirals such as the famous Whirlpool galaxy or M 51, discovered by Charles Messier.

NGC 3521 is bright and relatively close-by, and can easily be seen with a small telescope such as the one used by Messier to catalogue a series of hazy and comet-like objects in the 1700s. Strangely, the French astronomer seems to have missed this flocculent spiral even though he identified several other galaxies of similar brightness in the constellation of Leo.

It was only in the year that Messier published the final version of his catalogue, 1784, that another famous astronomer, William Herschel, discovered NGC 3521 early on in his more detailed surveys of the northern skies. Through his larger, 47-cm aperture, telescope, Herschel saw a "bright center surrounded by nebulosity," according to his observation notes.

In this new VLT picture, colourful, yet ill defined, spiral arms replace Herschel's "nebulosity." Older stars dominate the reddish area in the centre while young, hot blue stars permeate the arms further away from the core.

Oleg Maliy, who participated ESO's Hidden Treasures 2010 competition, selected the data from the FORS1 instrument on ESO's VLT at the Paranal Observatory in Chile that were used to create this dramatic image. Exposures taken through three different filters that passed blue light (coloured blue), yellow/green light (coloured green), and near-infrared light (coloured red) have been combined to make this picture. The total exposure times were 300 seconds per filter. Oleg's image of NGC 3521 was a highly ranked entry in the competition, which attracted almost 100 entries.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by European Southern Observatory - ESO.

http://www.sciencedaily.com/releases/2011/08/110810085506.htm

Profound Reorganization in Brains of Adults Who Stutter: Auditory-Motor Integration Located in Different Part of Brain

In adults who have stuttered since childhood the processes of auditory-motor integration are indeed located in a different part of the brain to those in adults who do not stutter, new research shows. (Credit: © marksykes / Fotolia)

ScienceDaily (Aug. 15, 2011) — Hearing Beethoven while reciting Shakespeare can suppress even a King's stutter, as recently illustrated in the movie "The King's Speech." This dramatic but short-lived effect of hiding the sound of one's own speech indicates that the integration of hearing and motor functions plays some role in the fluency (or dysfluency) of speech. New research has shown that in adults who have stuttered since childhood, the processes of auditory-motor integration are indeed located in a different part of the brain to those in adults who do not stutter.

The findings are reported in the September 2011 issue of Elsevier's *Cortex.*

Dr. Nicole Neef and Dr. Martin Sommer from the University of Goettingen, together with Dr. Bettina Pollok from the University of Duesseldorf, studied the performance of a group of adults who stutter, as well as a control group of adults who do not stutter, in a finger tapping exercise. They used Transcranial Magnetic Stimulation (TMS) to interfere temporarily with brain activity in the dorsolateral premotor cortex while the participants tapped their fingers in time with the clicks of a metronome. In control subjects, disturbing the left premotor cortex impaired the finger tapping, but disturbing the right premotor cortex had no effect. In stuttering adults, the pattern was reversed: the accuracy of finger tapping was affected by disturbing the right hemisphere, and unaffected when disturbing the left.

Previous research has already linked stuttering with a right-shifted cerebral blood flow in the motor and premotor areas during speech. In this new study, a shift of auditory-motor integration to the right side of the brain occurred even in a task not directly involving speech. Thus, in the brains of adults who stutter there appears to be a profound reorganization possibly compensating for subtle white matter disturbances in other parts of the brain -- the left inferior frontal regions. These findings shed light on the extent of the reorganization of brain functions in persistent developmental stuttering.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by Elsevier, via AlphaGalileo.

Journal Reference:

1. Nicole E. Neef, Kristina Jung, Holger Rothkegel, Bettina Pollok, Alexander Wolff von Gudenberg, Walter Paulus, Martin Sommer. Right-shift for non-speech motor processing in adults who stutter. *Cortex,* 2011; 47 (8): 945 DOI: 10.1016/j.cortex.2010.06.007

http://www.sciencedaily.com/releases/2011/08/110815113534.htm

Time need not end in the multiverse

- 11 August 2011 by Amanda Gefter
- Magazine issue 2825

No longer a worry (Image: Michael Skolund/Workbook/Getty)

GAMBLERS already had enough to think about without factoring the end of time into their calculations. But a year after a group of cosmologists argued that they should, another team says time need not end after all.

It all started with this thought experiment. In a back room in a Las Vegas casino, you are handed a fair coin to flip. You will not be allowed to see the outcome, and the moment the coin lands you will fall into a deep sleep. If the coin lands heads up, the dealer will wake you 1 minute later; tails, in 1 hour. Upon waking, you will have no idea how long you have just slept.

The dealer smiles: would you like to bet on heads or tails? Knowing it's a fair coin, you assume your odds are 50/50, so you choose tails. But the house has an advantage. The dealer knows you will almost certainly lose, because she is factoring in something you haven't: that we live in a multiverse.

The idea that our universe is just one of many crops up in a number of physicists' best theories, including inflation. It posits that different parts of space are always ballooning into separate universes, so that our observable universe is just a tiny island in an exponentially growing multiverse.

In any infinite multiverse, everything that can happen, will happen - an infinite number of times. That has created a major headache for cosmologists, who want to use probabilities to make predictions, such as the strength of the mysterious dark energy that is accelerating the expansion of our own universe. How can we say that anything is more or less probable than anything else?

One procedure physicists are fond of is to draw a cut-off at some finite time, count up the number of events - say, heads and tails - that occur in the multiverse before the cut-off time, and use that as a representative sample.

It seems reasonable, but when tackling the casino experiment, something strange happens. Wherever the cut-off is drawn, it slices through some of the gamblers' naps, making it appear as if those gamblers simply never woke up. The longer the nap, the more likely it is to be cut off, so if you do awaken, it's more likely that you

have taken a shorter nap - that is, that you flipped heads. So even though the odds seemed to be 50/50 when the coins were first flipped, heads becomes more probable than tails once you and the other gamblers wake up.

"This thought experiment was unbelievably perplexing at first, because it seemed like probabilities were changing from one instant to the next without any explanation," says Alan Guth of the Massachusetts Institute of Technology, who along with Vitaly Vanchurin of Stanford University in California, came up with the conundrum two years ago.

Last year, Raphael Bousso at the University of California, Berkeley, and colleagues devised an explanation that was effective, if unsettling. The changing probabilities were behaving as if time ends at the cut-off, they said, because time really does end at the cut-off. That's why the initial 50/50 odds change when you wake up from your nap.

Upon waking, you have new information: you know that time didn't end. That now means it is more likely that you only slept for a minute than for an hour. After all, time could end at any minute, and an hour has an extra 59 of those to spare. Heads wins.

The idea that time must end for the probabilities to make sense has been bugging Guth and Vanchurin for the last year. Now they say they have developed a mathematical explanation for the multiverse that saves the fourth dimension (arxiv.org/abs/1108.0665).

The essence of the argument is that you don't need any new information, in this case the fact that you woke up, to understand why the odds are no longer 50/50. In a multiverse that grows exponentially, where each new generation of universes is far larger than the last, younger universes always outnumber older ones. Waking up, you will either be in a universe in which 1 minute has passed (heads), or in a universe in which 1 hour has passed (tails). "The experiment sets up a 59-minute ambiguity in the age of the universe," Guth says. "You should always bet on the younger one."

But Bousso doesn't feel safe just yet: "Nature has often seemed crazy as we discovered how far removed its workings are from our everyday intuition. The end of time may sound crazy, but it is by far the simplest interpretation." Whether or not time is going to end, there's a lesson to take from the debate: should you wake up in Las Vegas, bet heads.

http://www.newscientist.com/article/mg21128253.700-time-need-not-end-in-the-multiverse.html

Increased Tropical Forest Growth Could Release Carbon from the Soil

Measuring CO2 efflux from the soil in subplots where the forest floor has been replaced with litter with a distinct isotopic signature. A wire mesh tent excludes forest litter from the subplots. (Credit: Dr. Emma Sayer)

ScienceDaily (Aug. 15, 2011) — A new study shows that as climate change enhances tree growth in tropical forests, the resulting increase in litterfall could stimulate soil micro-organisms leading to a release of stored soil carbon.

The research was led by scientists from the Centre for Ecology & Hydrology and the University of Cambridge, UK. The results are published online in the journal *Nature Climate Change*.

The researchers used results from a six-year experiment in a rainforest at the Smithsonian Tropical Research Institute in Panama, Central America, to study how increases in litterfall -- dead plant material such as leaves, bark and twigs which fall to the ground -- might affect carbon storage in the soil. Their results show that extra litterfall triggers an effect called 'priming' where fresh carbon from plant litter provides much-needed energy to micro-organisms, which then stimulates the decomposition of carbon stored in the soil.

Lead author Dr Emma Sayer from the UK's Centre for Ecology & Hydrology said, "Most estimates of the carbon sequestration capacity of tropical forests are based on measurements of tree growth. Our study demonstrates that interactions between plants and soil can have a massive impact on carbon cycling. Models of climate change must take these feedbacks into account to predict future atmospheric carbon dioxide levels."

The study concludes that a large proportion of the carbon sequestered by greater tree growth in tropical forests could be lost from the soil. The researchers estimate that a 30% increase in litterfall could release about 0.6 tonnes of carbon per hectare from lowland tropical forest soils each year. This amount of carbon is greater than estimates of the climate-induced increase in forest biomass carbon in Amazonia over recent decades. Given the vast land surface area covered by tropical forests and the large amount of carbon stored in the soil, this could affect the global carbon balance.

Tropical forests play an essential role in regulating the global carbon balance. Human activities have caused carbon dioxide levels to rise but it was thought that trees would respond to this by increasing their growth and taking up larger amounts of carbon. However, enhanced tree growth leads to more dead plant matter, especially leaf litter, returning to the forest floor and it is unclear what effect this has on the carbon cycle.

Dr Sayer added, "Soils are thought to be a long-term store for carbon but we have shown that these stores could be diminished if elevated carbon dioxide levels and nitrogen deposition boost plant growth."

Co-author Dr Edmund Tanner, from the University of Cambridge, said, "This priming effect essentially means that older, relatively stable soil carbon is being replaced by fresh carbon from dead plant matter, which is easily decomposed. We still don't know what consequences this will have for carbon cycling in the long term."

story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by Centre for Ecology & Hydrology, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Emma J. Sayer, Matthew S. Heard, Helen K. Grant, Toby R. Marthews, Edmund V. J. Tanner. Soil carbon release enhanced by increased tropical forest litterfall. *Nature Climate Change*, 2011; DOI: 10.1038/nclimate1190

http://www.sciencedaily.com/releases/2011/08/110814141445.htm

Mysterious Fossils Provide New Clues to Insect Evolution

This is a Coxoplectoptera adult. (Credit: Staatliches Museum für Naturkunde Stuttgart (Germany))

ScienceDaily (Aug. 15, 2011) — Scientists at the Stuttgart Natural History Museum and colleagues have discovered a new insect order from the Lower Cretaceous of South America. The spectacular fossils were named *Coxoplectoptera* by their discoverers and their findings were published in a special issue on Cretaceous Insects in the scientific journal *Insect Systematics & Evolution*.

The work group led by Dr. Arnold H. Staniczek and Dr. Günter Bechly, both experts on basal insects, determined that these fossils represent extinct relatives of modern mayflies. *Coxoplectoptera*, however, significantly differ from both mayflies and all other known insects in anatomy and mode of life.

With the discovery of adult winged specimens and excellently preserved larvae, the scientists were able to clarify the phylogenetic position of these animals and presented a new hypothesis regarding the relationships of basal winged insects. Equipped with wing venation of a mayfly, breast and wing shape of a dragonfly, and legs of a praying mantis, these winged insects look like a patchwork of various animals. The peculiar larvae, however, are reminiscent of freshwater shrimps. Their lifestyle turned out to be a major enigma: their mode of embedding and certain other characteristics clearly suggest a fluvial habitat. Their unique anatomy indicates that these animals were ambush predators living partly dug in the river bed.

These animals furthermore provided clues to the long-standing controversial debate of the evolutionary origin of the insect wing. The scientists presume that wings originated from thoracic backplates, while leg genes were recruited for their developmental control.

Story Source:

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

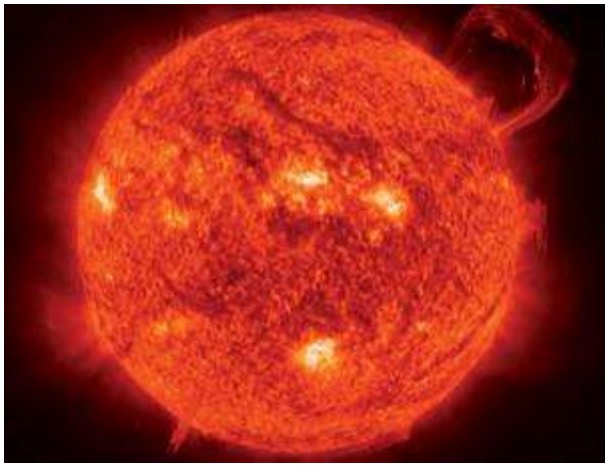
Journal Reference:

1. Arnold H. Staniczek, Günter Bechly, Roman J. Godunko. Coxoplectoptera, a new fossil order of Palaeoptera (Arthropoda: Insecta), with comments on the phylogeny of the stem group of mayflies (Ephemeroptera). *Insect Systematics & Evolution*, 2011; 42 (2): 101 DOI: 10.1163/187631211X578406

http://www.sciencedaily.com/releases/2011/07/110719072804.htm

Star power: Small fusion start-ups aim for break-even

- 16 August 2011 by David Hambling
- Magazine issue 2825.



Catching the sun (Image: SOHO/ESA/NASA)

Nuclear fusion will cost a fortune – or will it? A new wave of upstart companies think they've found cheaper, quicker ways to build a second sun

A VAST earth platform looms into view above the treetops of Cadarache in France's sultry south-east. It measures 1 kilometre long by 400 metres wide, and excavators dotted around it are digging out pits to be filled with massive, earthquake-proof concrete foundations. These foundations need to be strong: 18 giant, supercooled superconducting magnets, each weighing 360 tonnes, will be part of a payload totalling 23,000 tonnes. This is the site of ITER, an international scientific collaboration with funding of €15 billion.

Meanwhile, in an undistinguished building 9000 kilometres away on an industrial park in Redmond, Washington state, a handful of researchers are gathered around a slender cylindrical apparatus about 16 metres long. There are no massive foundations and no expensive cryogenics. The object of the researchers' interest is smaller than one of ITER's magnets.

The disparity in scale is striking, especially when you consider both pieces of kit have the same goal: to harness the awe-inspiring power of nuclear fusion. Which project is more likely to realise fusion's promise of clean, nigh-on inexhaustible energy? ITER certainly has the funding and the physics and engineering expertise. It would be most people's bet. Yet some diminutive upstarts are now challenging that assumption.

What the newcomers lack in size, they make up in ingenuity and dynamism, their backers say. In Redmond and elsewhere, they have gathered some serious money behind their promise to produce the first commercial fusion reactors within years, not the decades ITER will require. Could an upset be on the cards?

There's no secret to our interest in fusion: it is what powers the stars, including our sun. At the hundred-million-degree temperatures that exist in the sun's core, the nuclei of light atoms fuse together to form heavier

nuclei, liberating colossal amounts of energy - the energy that illuminates and warms our planet some 150 million kilometres distant. What we wouldn't give to tame that power for ourselves.

It's not that we haven't mastered the basics. Humanity's first successful experiment with fusion came on 1 November 1952, with the explosion of the first hydrogen bomb above the Pacific atoll of Enewetak in the Marshall Islands. That demonstrated two things. First, the energy needed to ignite a fusion reaction is huge: an H-bomb requires a Hiroshima-style atomic bomb to set it off. Second, once the reaction is under way, it is virtually uncontrollable.

The chequered history of fusion since then teaches us to be wary of claims to have tamed it (see "More lows than highs"). The magic "break-even" point, at which a reactor begins to produce more energy than it consumes, remains as elusive as ever. Despite our best efforts, for the past half-century practicable fusion has always been something like a half-century in the future.

Commercial fusion would start with two heavy isotopes of hydrogen - deuterium and tritium - compressed and heated to an almost unimaginable degree. Under such conditions, these atoms are stripped of their electrons and exist as a charged gas or "plasma". In this state, they can be induced to fuse to make helium nuclei, expelling a neutron in the process. The all-important by-product of this fusion reaction is a truly immense amount of energy: 1 kilogram of fusion fuel can produce as much energy as over 10,000 tonnes of coal. This fuel is relatively easy to come by, too. Unlike the heavy-atom fuels of nuclear fission, which must be expensively mined and refined, deuterium can be extracted from water. Tritium is rare in nature but can be "bred" by bombarding lithium with neutrons handily supplied by the fusion reaction itself.

Doughnut dreams

That masks a big problem, however: deuterium-tritium fusion only kicks in at temperatures above 45 million degrees. Not only does reaching such temperatures require a lot of energy, but no known material can withstand them once they have been achieved. The ultra-hot, ultra-dense plasma at the heart of a fusion reactor must instead be kept well away from the walls of its container using magnetic fields. Following a trick devised in the Soviet Union in the 1950s, the plasma is generated inside a doughnut or torus-shaped vessel, where encircling magnetic fields keep the plasma spiralling clear of the walls - a configuration known as a tokamak.

This confinement is not perfect: the plasma has a tendency to expand, cool and leak out, limiting the time during which fusion can occur. The bigger the tokamak, the better the chance of extracting a meaningful amount of energy, since larger magnetic fields hold the plasma at a greater distance, meaning a longer confinement time. The current record holder is the UK-based Joint European Torus (JET) tokamak, which has been operating at the Culham Science Centre in Oxfordshire since 1983. At 15 metres in diameter and 12 metres high it is no baby, but even JET has never quite reached break-even: its best performance is a 16-megawatt output for a 20-megawatt input. It sustained this for less than 10 seconds.

Break-even is the dream ITER was conceived to realise. With a confinement volume over four times JET's, ringed by magnetic fields almost three times as strong, it should contain a plasma for several minutes, ultimately producing 10 times as much power as is put in.

This long confinement time brings its own challenges. An elaborate system of gutters is needed to extract from the plasma the helium produced in the reaction, along with other impurities. The neutrons emitted, which are chargeless and so not contained by magnetic fields, bombard the inside wall of the torus, making it radioactive and meaning it must be regularly replaced. These neutrons are also needed to breed the tritium that sustains the reaction, so the walls must be designed in such a way that the neutrons can be captured on lithium to make tritium. The details of how to do this are still being worked out.

And the overall success of the project is by no means guaranteed. "We know we can produce plasmas with all the right elements, but when you are operating on this scale there are uncertainties," says David Campbell, a senior ITER scientist. Extrapolations from the performance of JET and its predecessors suggest a range of possible outcomes, he says. The most likely is that ITER will work as planned, delivering 10 times break-even energy. Yet there is a chance it might work better - or produce too little energy to be useful for commercial fusion.

ITER's great strength is that it builds on the well-established, well-tested physics of tokamaks. But it comes at a huge financial cost and is developing at a snail's pace. Even if all goes according to plan, the reactor will not produce its first plasma until 2019, and break-even is not expected until 2026 at the earliest.

The goal of ITER's new rivals is to reach that point more quickly - and far more cheaply. The Redmond device, dubbed the Fusion Engine, is the brainchild of a company called Helion Energy, and relies on a very different method of establishing and confining plasmas known as a field-reversed configuration. Discovered at the US Naval Research Laboratory in Washington DC in 1960, this process involves accelerating two small, compact balls of plasma into one another at a speed of hundreds of kilometres a second. The conditions created by the collision should, in theory, be sufficient to force the nuclei together, heat them and ignite fusion.

This method has some notable advantages. Although magnetic fields are still used to confine the plasmas, the arrangement is far less elaborate than a tokamak, so the device can be a lot smaller. The reaction is intense and is over in a fraction of a second, and neutrons are only produced at the point where the plasmas collide, making it easy to collect them to breed tritium.

In a peer-reviewed paper published in April this year, Helion researchers show how they used the technique to smash two plasmas together and achieve a temperature of 25 million degrees. That's still well below what is needed to ignite fusion, but the team also published calculations showing that ignition - and even break-even - should be possible in a device just three times the size of their prototype (*Nuclear Fusion*, vol 51, p 053008).

"We know it works with small high-density plasmas, and big low-density plasmas," says Phil Wallace, Helion's president. "It should work with big high-density plasma." The company, which has already received something like $5 million in funding from NASA and the US Department of Defense among others, is now looking for $20 million from private investors to build what it says could be a commercially viable reactor.

Also pursuing the dream is the Canadian firm General Fusion based in Burnaby, British Columbia, using a method called magnetised plasma fusion. This set-up also emerged from the US Naval Research Laboratory, this time in the late 1970s. It involves igniting fusion in a plasma violently compressed within a cavity created in a spinning sphere of liquid metal.

According to company spokesman Michael Delage, the first laboratory tests of the design have gone well, achieving a temperature of 5 million degrees for 1 microsecond. It remains to be seen whether this approach can be scaled up all the way to fusion - and beyond that to break-even. "There are no magnetised plasma experiments that we are aware of at the plasma temperatures and densities necessary for net-gain fusion," Delage says. "The only way to verify this is by experiment." The firm has raised the $30 million it says it needs, some of it from Amazon founder Jeff Bezos.

Utopian insanity

Tri Alpha Energy, a secretive California-based company, is believed to have raised $90 million for its variant of the field-reversed technique; among its investors is Microsoft co-founder Paul Allen. In a rare public communication a year ago, Tri Alpha researchers showed how they had collided two plasma balls at a

temperature over 5 million degrees and held them together for up to 2 milliseconds (*Physical Review Letters*, vol 105, p 045003). Tri Alpha says it will produce a working commercial reactor some time between 2015 and 2020 - possibly before ITER fires up for the first time.

Those are big claims, and a degree of scepticism would seem to be in order. And indeed you don't need to look far to find detractors. Alarm:clock, a website that tracks tech start-ups, has described the investment the fusion companies have attracted as "testament to the easy-money utopian green insanity which has gripped the imaginations of some of our best venture capitalists".

But - and here's the surprise - it's hard to find anyone in the know with anything bad to say about the physics behind the new reactors. Even ITER scientists admit that the technology is credible and superficially attractive, if still immature. "The tokamak is fairly complicated; some other approaches appear simpler and that appeals," says Campbell. "They look like a more direct route to fusion."

He's still not about to down tools and switch sides. The body of knowledge built up over the years means a tokamak is still the safest bet to reach break-even first, he says. "It may look like there's a neat idea waiting to come out, but experience shows there's always a catch."

Unsurprisingly, Delage has a different view. "It is worthwhile comparing not just the amount of past experimental work on each technology, but also the work remaining to commercialise it," he says. Even if ITER does reach break-even in 2026, it will have produced just heat, not the ultimate aim, electricity. More work will be needed to hook it up to a generator. "For ITER and tokamaks in general, commercialisation remains several decades away," says Delage.

The simplicity and smaller size of fusion reactors based on the new technologies - the companies are aiming for something on the 100-megawatt scale, rather than the gigawatts that are ITER's ultimate goal - could be their great advantage. "It's a size that allows for factory construction of systems rather than site-specific designs," says Delage. Wallace agrees. "ITER is not the sort of thing you could easily roll out in, say, Nigeria - but we can go anywhere," he says.

That is for the future. Wallace thinks the new machines might take off first not for power generation, but as neutron sources that could be used to "transmute" the highly radioactive waste from today's fission reactors into low-level isotopes and nuclear fuel. He estimates that 50 Fusion Engines of the size Helion is planning to build could within 20 years eliminate all the waste the US now has stockpiled. Once they are established as neutron sources that just happen to produce power, the small reactors could evolve into commercial power plants, he says.

Such claims have yet to be tested. Some see in the story of ITER and its smaller rivals a potential parallel with the story of the Concorde supersonic airliner, a billion-dollar investment by the British and French governments. Two decades in the making, Concorde was a technological triumph. Yet it was its less ambitious but more nimble and economical contemporary, the Boeing 737, that became the backbone of air travel. Whether history repeats itself or not, the race to exploit fusion's amazing potential is hotting up once more.

More lows than highs

Since the German physicist Hans Bethe first explained how nuclear fusion powers the stars in 1939, there have been many attempts to harness fusion on Earth - with mixed success.

1946 UK researchers Moses Blackman and George Thomson patent the Z-pinch, which uses powerful pulses of current in parallel conductors to squeeze a plasma and ignite fusion

1952 Following the design of Edward Teller and Stanisław Ulam, the first H-bomb is ignited by an atom bomb over the Pacific Ocean

1957 Researchers at the Zero Energy Thermonuclear Assembly (ZETA) in Harwell, Oxfordshire, UK, claim to have achieved fusion using the Z-pinch technique - a claim later withdrawn

1968 Soviet researchers demonstrate high confinement temperatures with their T3 tokamak. The doughnut-shaped design goes on to dominate fusion research

1983 The Joint European Torus (JET) tokamak starts up in the UK

1989 Martin Fleischmann and Stanley Pons claim to have initiated nuclear fusion at room temperature by electrolysing deuterium-containing heavy water. Others fail to replicate the effect. Though still pursued by some, "cold fusion" becomes a byword for bad science

2002 Rusi Taleyarkhan and colleagues at Oak Ridge National Laboratory, Tennessee, claim to have ignited fusion in collapsing bubbles made by zapping deuterated acetone with ultrasound. "Bubble fusion" remains highly controversial

2005 Funded largely by the US navy, the Polywell device aims to use a series of magnetic fields to ignite fusion by accelerating positive ions and trapped electrons. Tests show some small-scale successes, but as of 2011 the technique has yet to be scaled up

2007 Construction work starts on ITER in Cadarache, France

2009 The US National Ignition Facility in Livermore, California, opens. NIF uses powerful lasers to compress and heat hydrogen fuel and so initiate fusion for military and astrophysical research

2011 Italian inventer Andrea Rossi claims to have devised a cold-fusion "Energy Catalyzer"

2014 A scaled-up version of a prototype Stellarator is due for completion at the Max Planck Institute for Plasma Physics in Greifswald, Germany. The device stretches out and twists a tokamak's doughnut shape to make confinement possible with a single magnetic field

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http://www.newscientist.com/article/mg21128251.400-star-power-small-fusion-startups-aim-for-breakeven.html

Effortless Sailing With Fluid Flow Cloak

Boat with wake. Researchers have demonstrated the theoretical ability to significantly increase the efficiency of ships by tricking the surrounding water into staying still. (Credit: © lunamarina / Fotolia)

ScienceDaily (Aug. 15, 2011) — Duke engineers have already shown that they can "cloak" light and sound, making objects invisible. Now, they have demonstrated the theoretical ability to significantly increase the efficiency of ships by tricking the surrounding water into staying still.

"Ships expend a great deal of energy pushing the water around them out of the way as they move forward," said Yaroslav Urzhumov, assistant research professor in electrical and computer engineering at Duke's Pratt School of Engineering. "What our cloak accomplishes is that it reduces the mass of fluid that has to be displaced to a bare minimum.

"We accomplish this by tricking the water into being perfectly still everywhere outside the cloak," Urzhumov said. "Since the water is still, there is no shear force, and you don't have to drag anything extra with your object. So, comparing a regular vessel and a cloak of the same size, the latter needs to push a much smaller volume of water, and that's where the hypothesized energy efficiency comes from."

The results of Urzhumov's analysis were published online in the journal *Physical Review Letters*. The research was supported by the U.S. Office of Naval Research and a Multidisciplinary University Research Initiative (MURI) grant through the U.S. Army Research Office. Urzhumov works in the laboratory of David R. Smith, William Bevan Professor of electrical and computer engineering at Duke.

While the cloak postulated by Urzhumov differs from other cloaks designed to make objects seem invisible to light and sound, it follows the same basic principles -- the use of a human-made material that can alter the normal forces of nature in new ways.

In Urzhumov's fluid flow cloak, he envisions the hull of a vessel covered with porous materials -- analogous to a rigid sponge-like material -- which would be riddled with holes and passages. Strategically placed within this material would be tiny pumps, which would have the ability to push the flowing water along at various forces.

"The goal is make it so the water passing through the porous material leaves the cloak at the same speed as the water surrounding by the vessel," Urzhumov said. "In this way, the water outside the hull would appear to be still relative to the vessel, thereby greatly reducing the amount of energy needed by the vessel to push vast quantities of water out of the way as it progresses."

While the Duke invisibility cloak involved a human-made structure -- or metamaterial -- based on parallel rows of fiberglass slats etched with copper, Urzhumov envisions a different sort of metamaterial for his fluid flow cloak.

"In our case, I see this porous medium as a three-dimensional lattice, or array, of metallic plates," he said. "You can imagine a cubic lattice of wire-supported blades, which would have to be oriented properly to create drag and lift forces that depend on the flow direction. In addition, some of the cells of this array would be equipped with fluid-accelerating micro-pumps."

Urzhumov explained that when a regular vessel moves through fluid, it also pushes and displaces a volume of water that greatly exceeds the volume of the vessel itself. That is because in a viscous fluid like water, an object cannot just move a single layer of water without all others; the shear force effectively attaches an additional mass of water to the object.

"When you try to drag an object on a fishing line through water, it feels much heavier than the object itself, right?" he said. "That's because you are dragging an additional volume of water with it."

Based on this understanding of the flow cloaking phenomenon, Urzhumov believes that the energy expended by the micropumps could be significantly less than that needed to push an uncloaked vessel through the water, leading to the greatly improved efficiency.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by Duke University. The original article was written by Richard Merritt.

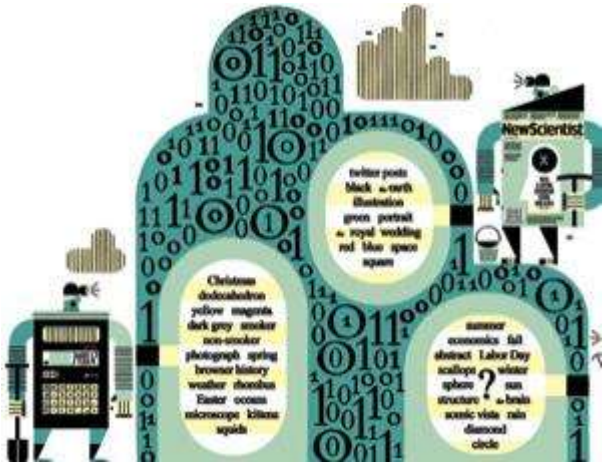
Journal Reference:

1. Yaroslav Urzhumov, David Smith. Fluid Flow Control with Transformation Media. *Physical Review Letters*, 2011; 107 (7) DOI: 10.1103/PhysRevLett.107.074501

http://www.sciencedaily.com/releases/2011/08/110811162823.htm

Datacasting: What will you buy tomorrow?

- 18 August 2011 by Jim Giles and Peter Aldhous
- Magazine issue 2825.



Mining the future (Image: Raymond Biesinger/Debut Art)

We put a new breed of number-crunching forecasters to their toughest test yet – predicting sales of New Scientist

CROESUS, the king of ancient Lydia, wanted to know the future. It wasn't going to be easy. First he had to climb the slopes of mount Parnassus to consult the Pythia, a Greek oracle. Those granted an audience received a prophecy, but only if they brought along a sacrificial goat. Having heard the prophecy, expressed in enigmatic verse, they then had to figure out what it meant. Croesus was told that a great empire would fall if he went to war. He invaded his Persian neighbours, only to discover that the ill-fated empire was his own.

It might seem as if little has changed. Business leaders and politicians still turn to forecasters, who often charge high sums for their services. And yet their predictions can be unhelpful, if not wildly inaccurate. Many technology analysts said the iPad would be a flop; it has sold tens of millions. The movie *Titanic* was supposedly destined for a fate as miserable as the ship; it earned almost $2 billion. As the old joke goes, prediction is hard - especially about the future.

Yet there is a buzz about the prediction business. That's because forecasters have a new place to look for answers. This time, their efforts are based on data - mountains of data, in fact. Our online activities are now tracked in unprecedented detail. Sensors monitor everything from hospital treatments to road conditions. Data storage is so cheap that many large companies are sitting on enough information to fill a million compact discs. The global data mountain is growing by 40 per cent annually.

This information is a potential gold mine. People who can extract trends are much in demand, with job ads seeking "quantitative rock stars" and "stats ninjas". The fledgling field of data science can already predict traffic flows, help doctors make better decisions and tell a turkey from a future box-office smash. In fact, data science has probably changed your day-to-day life without you realising it.

So how is the new forecasting done, and just how good is it? We decided to see how the latest techniques would stand up to the task of predicting what people will buy - one of the hottest challenges in the field. Finding a suitable test wasn't difficult. Every week, we at *New Scientist* strive to present a magazine you'd want to pick up. So, over the past four months, we have set four teams the task of trying to predict the sales of each issue of *New Scientist*, using some of the most promising and innovative approaches available. Are our readers predictable, we dared to wonder?

It won't spoil the ending if we tell you that the experiment's results have been mixed. The task turned out to be far more complex than we thought. Yet along the way, we discovered how data science is set to transform the world we live in, for better and for worse. Read on to find out what happened - and to learn about the gallant failure of our wild-card forecasting team: a quartet of pigeons.

Early exits

Predicting magazine sales is notoriously hard, so we figured that our exercise would provide data science with a stiff test. Still, we found forecasters who were willing to give it a try. To get them started, we had each hone their techniques on historic data - sales of *New Scientist* between 2006 and 2010 in UK stores. We also provided images of all the magazine covers, figuring that these are likely to have influenced sales significantly. The forecasters were free to study any other data they deemed useful, from weather reports to economic indicators.

If there was a straightforward pattern in the sales figures, the teams should have found it. But several entrants fell at this first hurdle, including data scientists at the University of California, Berkeley, and nearby Stanford University, who looked at the numbers and scratched their heads.

Further evidence of the task's magnitude came from Johan Bollen at Indiana University Bloomington. He is one of the foremost practitioners of an exciting new idea - predicting the future by aggregating information from social networks. Positive tweets about a forthcoming movie, for example, are an indicator of good box-office returns. Bollen has used sentiments expressed on Twitter to forecast stock-market movements, and wanted to examine the connection between tweets about *New Scientist* and the magazine's sales. "We were absolutely convinced we were going to see a correlation," says Bollen. Yet none emerged.

A team of forecasting pigeons, which we had been secretly rooting for, also stumbled early on (see "Bird brains").

Then our luck appeared to change. Some of the groups looking at the sales figures began to identify patterns with modest predictive power. So, in March we decided to set up a 17-week contest in which entrants had to use the cover to predict sales before the magazine came out.

Max Sklar and Matthew Rathbone at New York University started by identifying and extrapolating long-term trends in our sales. Then they came up with a method for adjusting forecasts to take account of a seasonal variation that they discovered. Finally, they tweaked forecasts according to another pattern they found in the data: issues with pale covers sold slightly more than those with dark ones.

Basing forecasts on historical examples is a well-established approach in data science. Yahoo News, for example, monitors the behaviour of visitors to its website and uses the data it collects to decide what headlines to display next time that person visits. Data scientists also analyse old insurance claims for patterns that suggest fraud, while those in the tourism business use historic visitor numbers and economic data, such as wage levels and the price of plane tickets, to guess your next holiday destination. The approach has even been used to predict road traffic up to 24 hours ahead (see "Meet the Kagglers").

Indeed, by using a similar method, Sklar and Rathbone got off to a reasonable start. Their opening forecast was within 1000 copies of the actual figure - not bad considering that weekly sales can vary by several thousand. But the very next week, the gap was more than five times their initial miss. As the contest draws to a close, Sklar and Rathbone have only got within 1000 of the true sales figure on four more occasions.

Market traders

Our second entrant - a "prediction market" - didn't fare much better. These markets date back to work in the 1990s by Robin Hanson, an economist at George Mason University in Fairfax, Virginia, and rely on collating human judgement. In a regular stock market, a company's share price is effectively the aggregate of traders' forecasts about the firm's future. Hanson realised that this "wisdom of the crowd" could be used to forecast other events. Markets for "shares" in election outcomes and box-office takings have since proved to be powerful forecasting tools.

Consensus Point of Nashville, Tennessee, a company that employs Hanson as chief scientist, set up a prediction market involving *New Scientist* staff. Around 25 of us used an online interface to express how much confidence we had in each edition of the magazine. If we thought a cover had big potential to drive sales, for example, we would buy shares in it. Our collective decisions would drive up or depress the share price. The closing price each week was used to predict how well that issue would sell.

Such markets give forecasters a powerful picture of where the consensus lies, because they take account of people's confidence in their prediction. The markets are also useful when you suspect the results of a forecast could change as time passes. For example, a prediction about a politician's chances in an election will evolve as their campaign runs.

Yet for this task, as a crowd we did not prove wise. The technique fared no better than Sklar and Rathbone's.

A different crowd turned out to have more smarts. Websites like Amazon's Mechanical Turk allow users to commission workers to complete tasks in return for a small payment. Cellphone companies already use such services to get rapid feedback on new designs. Perhaps workers could also forecast sales?

We turned to CrowdFlower, a San Francisco-based company that helps clients outsource tasks to the online labour pool. It became our third entrant. CrowdFlower intern Diyang Tang started by asking workers to rate old covers. Their answers didn't tell her anything useful. But then she asked if they would pay $10 - almost twice the actual price - to buy the corresponding issue. The fraction of workers that said yes correlated with historic sales, so she applied this approach in the contest.

In the last days of the contest, the "Turkers" were battling it out for first place with our final contestant, Sebastian Wernicke, a former bioinformatics statistician based in Munich. Wernicke applied a statistical algorithm to the task, and like Sklar and Rathbone, was looking to patterns in the past to predict the future. He ran a pixel-by-pixel analysis of each cover that revealed the distribution of different colours. He also considered the topics, wording and image type. Details of public holidays were thrown into the mix on the assumption that time off may affect reading habits.

Wernicke adjusted the importance of each variable, noting the impact on the algorithm's ability to estimate historical sales. Over multiple rounds of tweaking, the algorithm became more accurate. Too much purple is a bad thing, Wernicke found. Printing the magazine's title in black is good. His technique, known as regression analysis, is one of the oldest forecasting methods. It is often the first one that forecasters turn to when trying to find relevant factors.

Wernicke got off to a flying start, making the most accurate forecast for the first four weeks of the contest. For three of those weeks, he got within a few hundred of the correct figure.

Then he began missing by thousands. One week in May, his forecast was out by over 5500. He was not alone - all the teams, including the Turkers, fared poorly during this period. Near the end the errors reduced, but the disastrous run in the middle of the competition may have scuppered the chances of any of the methods having useful forecasting power.

Thrown off

It was then that the magnitude of our challenge dawned, rather belatedly. Even the most carefully constructed algorithms can be derailed. Our forecasters were thrown off by a sales surge in April and May that went against precedent. Why? Perhaps the modest gains made by the UK economy played a role. Maybe our competitors published a series of duds. Readers may even have sought solace in science as other media overdosed on the recent royal wedding. The list of possible factors is lengthy, and including them all in a forecasting model would be a formidable task.

Our experience shows how difficult it is to identify all the elements that drive change. Miss just one or two factors, and a forecast can go awry. It is a reminder to any decision-maker swept up in the forecasting boom: large datasets and sophisticated statistical algorithms have the potential for awesome predictive power, but they are not infallible.

We also have an admission to make: we are just a tiny bit relieved that these techniques failed to foretell the future. It hints that data science can't predict your every desire just yet. Trouble can arise when businesses attempt this. Eli Pariser, author of *The Filter Bubble: What the internet is hiding from you*, describes two friends who searched Google for information about Egypt. One received links to news of the country's recent political turmoil, the other was pointed to travel websites. In trying to guess what Pariser's friends would be interested in, Google ended up filtering out important information.

Our competition raises similar questions. What will media companies do if forecasting algorithms tell them to avoid certain topics, like foreign news? And what about politics? Will on-demand forecasts of public reaction cause politicians to abandon a principled stand? This already happens via the results of surveys and focus groups, but the ability to forecast the impact of every small decision in close to real time will bring these tensions into sharper focus.

That's why we are not wholly sad that we couldn't predict what was to come. The more we turn to forecasts, the more we change the present - and sometimes for the worse. Even King Croesus would appreciate that.

See gallery: "Brains, delusion, mummies: Best *New Scientist* covers"

Bird brains

Paula, Trisha, George and Judith live in Austria. Recently we asked them to predict the future. Our unlikely clairvoyants are pigeons.

The pigeon quartet was a potential wild-card entrant in a contest we have been running for the past few months. Various teams have been using data science to try to predict the weekly sale figures of *New Scientist* magazine (see main story). Unfortunately the birds failed early on.

While pitting pigeons against top number-crunchers might seem fanciful, if the visual structure of the magazine cover has a major impact on sales, then the birds should have had a decent shot. Pigeons are capable of impressive feats of visual-discrimination learning.

Tanja Kleinhappel, a student in the lab of Ludwig Huber at the University of Vienna, Austria, used food rewards to train the pigeons to distinguish between high and low-selling covers. It took a while, but each of the birds learned to categorise the covers according to sales with more than 80 per cent reliability.

Sadly, when Kleinhappel started introducing new covers, the pigeons' performance dropped back to the chance level. They had learned how the covers they were trained on had sold, but had not latched on to an underlying pattern correlated with sales.

One consolation? Part of our editor's job is unlikely to be outsourced to the pigeon coop any time soon.

Meet the Kagglers

Wouldn't it be useful to have an accurate traffic forecast? In Sydney, Australia, road-surface sensors log passing cars to gauge congestion. To find out if this data could be used to forecast travel times, the government of New South Wales turned to Kaggle, a company that runs forecasting contests.

Kaggle has run 20 competitions to date. In one ongoing challenge, $3 million is up for grabs for anyone who can use health records to predict which people will end up in hospital.

For the traffic challenge, entrants had access to just over a year's worth of sensor readings, together with associated travel times. They had three months to search for patterns that could predict traffic conditions up to 24 hours ahead. At stake was a prize of A$10,000.

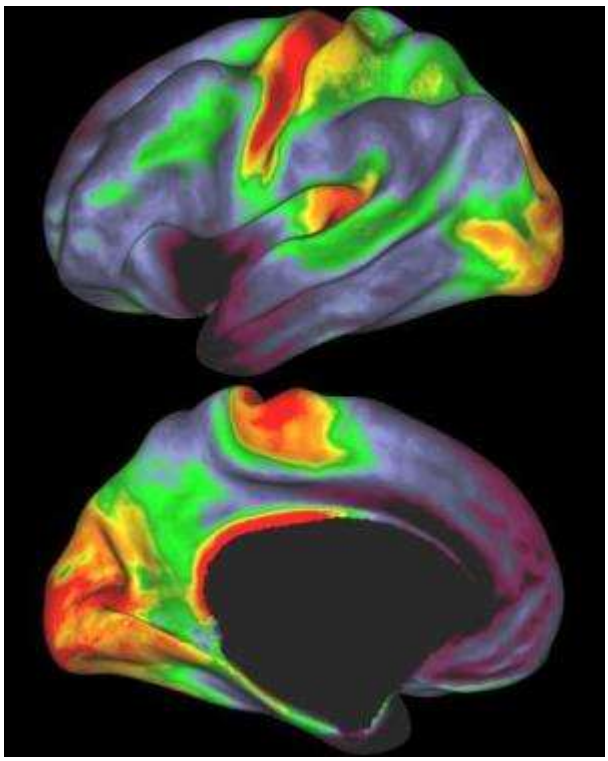
José González-Brenes of Carnegie Mellon University in Pittsburgh, Pennsylvania, took on the challenge. He and teammate Guido Matias Cortes of the University of British Columbia in Vancouver, Canada, came up with a "decision tree" model. They began by grouping the historical data into chunks using a series of questions such as "was it a weekday?" and "was traffic busy on neighbouring roads?".

Each chunk was associated with a characteristic set of travel times, so to make a forecast, González-Brenes and Cortes just had to use the same set of questions to determine which category any set of new conditions would best fit into. Their algorithm was able to predict travel times over a 500-metre stretch of road 24-hours in advance to within about 5 seconds - good enough to take first prize.

Jim Giles is a consultant for New Scientist. Peter Aldhous is our San Francisco bureau chief

http://www.newscientist.com/article/mg21128251.500-datacasting-what-will-you-buy-tomorrow.html

Scientists Have New Help Finding Their Way Around Brain's Nooks and Crannies



Scientists have found a way to use MRI scanning data to map myelin, a white sheath that covers some brain cell branches. Such maps, previously only available via dissection, help scientists determine precisely where they are at in the brain. Red and yellow indicate regions with high myelin levels; blue, purple and black areas have low myelin levels. (Credit: David Van Essen)

ScienceDaily (Aug. 15, 2011) — Like explorers mapping a new planet, scientists probing the brain need every type of landmark they can get. Each mountain, river or forest helps scientists find their way through the intricacies of the human brain.

Researchers at Washington University School of Medicine in St. Louis have developed a new technique that provides rapid access to brain landmarks formerly only available at autopsy. Better brain maps will result, speeding efforts to understand how the healthy brain works and potentially aiding in future diagnosis and treatment of brain disorders, the researchers report in the *Journal of Neuroscience* Aug. 10.

The technique makes it possible for scientists to map myelination, or the degree to which branches of brain cells are covered by a white sheath known as myelin in order to speed up long-distance signaling. It was developed in part through the Human Connectome Project, a $30 million, five-year effort to map the brain's wiring. That project is headed by Washington University in St. Louis and the University of Minnesota.

"The brain is among the most complex structures known, with approximately 90 billion neurons transmitting information across 150 trillion connections," says David Van Essen, PhD, Edison Professor and head of the Department of Anatomy and Neurobiology at Washington University. "New perspectives are very helpful for understanding this complexity, and myelin maps will give us important insights into where certain parts of the brain end and others begin."

Easy access to detailed maps of myelination in humans and animals also will aid efforts to understand how the brain evolved and how it works, according to Van Essen.

Neuroscientists have known for more than a century that myelination levels differ throughout the cerebral cortex, the gray outer layer of the brain where most higher mental functions take place. Until now, though, the only way they could map these differences in detail was to remove the brain after death, slice it and stain it for myelin.

Washington University graduate student Matthew Glasser developed the new technique, which combines data from two types of magnetic resonance imaging (MRI) scans that have been available for years.

"These are standard ways of imaging brain anatomy that scientists and clinicians have used for a long time," Glasser says. "After developing the new technique, we applied it in a detailed analysis of archived brain scans from healthy adults."

As in prior studies, Glasser's results show highest myelination levels in areas involved with early processing of information from the eyes and other sensory organs and control of movement. Many brain cells are packed into these regions, but the connections among the cells are less complex. Scientists suspect that these brain regions rely heavily on what computer scientists call parallel processing: Instead of every cell in the region working together on a single complex problem, multiple separate teams of cells work simultaneously on different parts of the problem.

Areas with less myelin include brain regions linked to speech, reasoning and use of tools. These regions have brain cells that are packed less densely, because individual cells are larger and have more complex connections with neighboring cells.

"It's been widely hypothesized that each chunk of the cerebral cortex is made up of very uniform information-processing machinery," Van Essen says. "But we're now adding to a picture of striking regional differences that are important for understanding how the brain works."

According to Van Essen, the technique will make it possible for the Connectome project to rapidly map myelination in many different research participants. Data on many subjects, acquired through many different analytical techniques including myelination mapping, will help the resulting maps cover the range of anatomic variation present in humans.

"Our colleagues are clamoring to make use of this approach because it's so helpful for figuring out where you are in the cortex, and the data are either already there or can be obtained in less than 10 minutes of MRI scanning," Glasser says.

This research was funded by the National Institutes of Health (NIH).

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

Journal Reference:

1. M. F. Glasser, D. C. Van Essen. Mapping Human Cortical Areas In Vivo Based on Myelin Content as Revealed by T1- and T2-Weighted MRI. *Journal of Neuroscience*, 2011; 31 (32): 11597 DOI: 10.1523/JNEUROSCI.2180-11.2011

http://www.sciencedaily.com/releases/2011/08/110809184153.htm

Lottery wins come easy, if you can spot the loopholes

- 19 August 2011 by Ferris Jabr
- Magazine issue 2826.

Winning scratch cards aren't always allocated in a random way (Image: Aristide Economopoulos/Star Ledger/Corbis)

SOME lottery players don't wish for luck, they make their own. Yet the recent spate of US "lotto-hacker" revelations do not involve high-tech gadgets like those used by the casino-robbing team in the film *Ocean's Eleven* but a knack for spotting patterns and exploiting loopholes.

Take consultant statistician Mohan Srivastava of Toronto, Canada. In January, *Wired* magazine explained how, back in 2003, Srivastava learned to predict which Ontario Lottery scratch cards were winners. Each card contains a visible section showing numbers between 1 and 39, and a "scratchable" section, where hidden numbers might match the visible ones.

Srivastava suspected these winning cards weren't randomly assigned but the result of a piece of software called a pseudo-random number generator. Indeed, he found that cards containing a row of three numbers that each appear only once on the card's visible section were almost always winners.

He could have bought reams of cards, picked out the winners and sold the rest, but instead Srivastava sent the Ontario Lottery and Gaming Corporation two piles of 10 unscratched cards, one marked winners, one losers. Two hours later he received a call telling him he had correctly identified 19 out of 20 cards. A day later, the game was toast.

Harpers magazine, meanwhile, recently described how a former mathematician who has won the Texas Lottery four times, netting her $20 million, might have exploited the use of pseudo-randomness.

Techniques that produce truly random sequences, such as selecting balls from a tumbler or others based on thermal noise, would eliminate these susceptibilities. But Srivastava, who in the wake of *Wired*'s story met with Ontario Lottery executives, says lotteries avoid these because they want to control how many people win to ensure a profit. "Their mandate is to create an alternative source of revenue for the government." And that means the statistically savvy can mop up the prizes. In the interests of transparency, he suggests lotteries state on tickets that the game is susceptible to plundering.

Pseudo-randomness had nothing to do with another case, in which Majorie and Gerald Selbee, the couple behind gambling company GS Investment Strategies, strategically played Massachusetts's Cash WinFall, winning nearly $1 million so far this year.

Winning numbers in this game are truly random. The weakness the couple exploit arises in the weeks after no one wins the jackpot and the extra money is poured into smaller prizes. Along with computer science graduates, the couple spotted that buying at least $100,000 worth of tickets in such a week ensures a profit. The lottery corporation has now suspended sales at some stores that made it easy to buy vast numbers of tickets. But it says that there is no problem with the game itself, which generates $11.8 million a year in profit.

Lotteries may have another motive, says Srivastava. "The revelation of flaws actually stokes people's appetite for the game. People are coming out of the woodwork saying, 'I can do that too! I can find the pattern!'"

http://www.newscientist.com/article/mg21128264.900-lottery-wins-come-easy-if-you-can-spot-the-loopholes.html

Like Humans, Chimps Are Born With Immature Forebrains

Young chimp. In both chimpanzees and humans, portions of the brain that are critical for complex cognitive functions, including decision-making, self-awareness and creativity, are immature at birth. But there are important differences, too. Baby chimpanzees don't show the same dramatic increase in the volume of prefrontal white matter in the brain that human infants do. (Credit: © Duncan Noakes / Fotolia)

ScienceDaily (Aug. 14, 2011) — In both chimpanzees and humans, portions of the brain that are critical for complex cognitive functions, including decision-making, self-awareness and creativity, are immature at birth. But there are important differences, too. Baby chimpanzees don't show the same dramatic increase in the volume of prefrontal white matter in the brain that human infants do.

Those are the conclusions of a study reported in the August 11th *Current Biology* that is the first to track the development of the chimpanzee brain over time and to make the comparison to humans.

"One of the most marked evolutionary changes underlying human-specific cognitive traits is a greatly enlarged prefrontal cortex," said Tetsuro Matsuzawa of Kyoto University in Japan. "It is also one of the latest-developing brain regions of the cerebrum."

That built-in developmental delay, now shown to be shared with chimps, may provide an extended period of plasticity, allowing both humans and our closest evolutionary cousins to develop complex social interactions, knowledge and skills that are shaped by life experiences, the researchers say.

"Both humans and chimpanzees need to render their neural network and brain function more susceptible to the influence of postnatal experience," Matsuzawa said.

For instance, he added, both chimps and humans enjoy close relationships between infants and adults, as indicated by smiles and mutual gazes. On the other hand, the greater prefrontal expansion in the human brain may contribute to the development of language, complex social interaction and other abilities that are unique to us.

Matsuzawa's team made their discoveries by studying magnetic resonance imaging (MRI) scans of three growing chimpanzees from the age of six months to six years, when chimps reach pre-puberty.

The findings suggest that a less mature and more protracted elaboration of neuronal connections in the prefrontal portion of the developing brain existed in the last common ancestor of chimpanzees and humans. That commonality is in contrast to what has been observed in studies of our more distant ancestors, the macaques.

Matsuzawa says his group is interested in exploring when over the course of evolutionary time this feature of brain development evolved. His team also hopes to explore the comparison between human and chimpanzee brains into young adulthood, noting that the chimpanzees they studied have entered late puberty at 11-years-old.

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

Journal Reference:

1. Tomoko Sakai, Akichika Mikami, Masaki Tomonaga, Mie Matsui, Juri Suzuki, Yuzuru Hamada, Masayuki Tanaka, Takako Miyabe-Nishiwaki, Haruyuki Makishima, Masato Nakatsukasa et al. Differential Prefrontal White Matter Development in Chimpanzees and Humans. *Current Biology*, 11 August 2011 DOI: 10.1016/j.cub.2011.07.019

http://www.sciencedaily.com/releases/2011/08/110811121326.htm

Ancient Egyptians believed in coiffure after death

- 18:11 18 August 2011 by Cian O'Luanaigh

Going anywhere nice for your holiday? (Image: Time Life Pictures/Getty)

Ancient Egyptians wouldn't be caught dead without hair gel. Style in the afterlife was just as important as it was during life on Earth – and coiffure was key.

To this end, men and women alike would have their tresses styled with a fat-based "gel" when they were embalmed. The evidence of their vanity has been found in a community cemetery dating back 3000 years.

Tomb paintings depict people with cone-shaped objects sitting on their heads, thought to be lumps of scented animal fat. "Once we started looking [for these], we found interesting hairstyles," says Natalie McCreesh of the University of Manchester, UK. "The hair was styled and perfectly curled."

She and her colleagues examined hair samples from 15 mummies from the Kellis 1 cemetery in Dakhla oasis, Egypt, and a further three samples from mummies housed in museum collections in the US, the UK and Ireland. The mummies were of both sexes, between 4 and 58 years old when they died, and dated from 3500 years to 2300 years ago.

When examined with light and electron microscopes, it became clear that the hairs of most mummies were coated with a fatty substance, though a few had been coiffed with something resinous.

Because they're worth it

The team used a solvent to separate the coatings from the hairs and determined the coatings' chemical composition. They found that the substances were different to those commonly used to embalm bodies. By contrast, two mummies whose heads had been shaved carried the same embalming materials on their heads as on the bandages around the body.

It seems, says McCreesh, that when a body was being coated in resinous materials, the hair would be covered and protected, or washed and restyled, in order to preserve the dead person's identity.

Maria Perla Colombini of the University of Pisa, Italy, points out that Egyptians were not the only ancient society to worry about mummified hair care. In South America, bodies were preserved with resin and pitch, and the hair coloured with powder, she says.

"People presume the ancient Egyptians shaved their heads. The priests and priestesses did, but not everyone. They did take pride in their appearance," says McCreesh.

"The whole point of mummification was to preserve the body as in life. I guess they wanted to look their best. You'd be dressed in your fancy party outfit. You'd want to look beautiful in preparation for the next life".

Journal reference: *Journal of Archaeological Science*, DOI: 10.1016/j.jas.2011.08.004

http://www.newscientist.com/article/dn20809-ancient-egyptians-believed-in-coiffure-after-death.html

Searching for Spin Liquids: Much-Sought Exotic Quantum State of Matter Can Exist

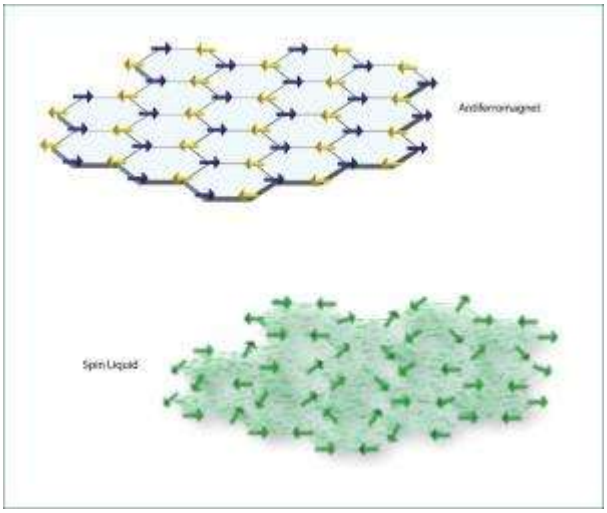


Diagram depicting anti-ferromagnetic order (upper) compared to a spin liquid phase (lower). In an anti-ferromagnet, the spins are anti-aligned. A spin liquid has no order and the spins can be viewed as bobbing about like water molecules in liquid water. (Credit: E. Edwards)

ScienceDaily (Aug. 14, 2011) — The world economy is becoming ever more reliant on high tech electronics such as computers featuring fingernail-sized microprocessors crammed with billions of transistors. For progress to continue, for Moore's Law -- according to which the number of computer components crammed onto microchips doubles every two years, even as the size and cost of components halves -- to continue, new materials and new phenomena need to be discovered.

Furthermore, as the sizes of electronic components shrink, soon down to the size of single atoms or molecules, quantum interactions become ever more important. Consequently, enhanced knowledge and exploitation of quantum effects is essential. Researchers at the Joint Quantum Institute (JQI) in College Park, Maryland, operated by the University of Maryland and the National Institute of Standards and Technology (NIST), and at Georgetown University have uncovered evidence for a long-sought-after quantum state of matter, a spin liquid.

The research was performed by JQI postdoctoral scientists Christopher Varney and Kai Sun, JQI Fellow Victor Galitski, and Marcos Rigol of Georgetown University. The results appear in an editor-recommended article in the 12 August issue of the journal *Physical Review Letters*.

You can't pour a spin liquid into a glass. It's not a material at all, at least not a material you can touch. It is more like a kind of magnetic disorder within an ordered array of atoms. Nevertheless, it has many physicists excited.

To understand this exotic state of matter, first consider the concept of spin, which is at the heart of all magnetic phenomena. For instance, a refrigerator magnet, at the microscopic level, consists of trillions of trillions of iron atoms all lined up. Each of these atoms can be thought of loosely as a tiny spinning ball. The orientation of that spin is what makes the atom into a tiny magnet. The refrigerator magnet is an example of a ferromagnet, the ferro part coming from the Latin word for iron. In a ferromagnet, all the atomic spins are lined up in the same way, producing a large cooperative magnetic effect.

Important though they may be, ferromagnets aren't the only kind of material where magnetic interactions between spins are critical. In anti-ferromagnets, for instance, the neighboring spins are driven to be anti-

aligned. That is, the orientations of the spins alternate up and down (see top picture in figure). The accumulative magnetic effect of all these up and down spins is that the material has no net magnetism. The high-temperature superconducting materials discovered in the 1980s are an important example of an anti-ferromagnetic structure.

More complicated and potentially interesting magnetic arrangements are possible, which may lead to a quantum spin liquid. Imagine an equilateral triangle, with an atom (spin) at each corner. Anti-ferromagnetism in such a geometry would meet with difficulties. Suppose that one spin points up while a second spin points down. So far, so good. But what spin orientation can the third atom take? It can't simultaneously anti-align with both of the other atoms in the triangle. Physicists employ the word "frustration" to describe this baffling condition where all demands cannot be satisfied.

In everyday life frustration is, well, frustrating, and actually this condition is found throughout nature, from magnetism to neural networks. Furthermore, understanding the different manifestations of a collection of magnetically interacting spins might help in designing new types of electronic circuitry.

One compromise that a frustrated spin system makes is to simultaneously exist in many spin orientations. In a quantum system, this simultaneous existence, or superposition, is allowed.

Here's where the JQI researchers have tried something new. They have studied what happens when frustration occurs in materials with a hexagonal (six sided) unit cell lattice.

What these atoms do is interact via their respective spins. The strength of the interaction between nearest neighbor (NN) atoms is denoted by the parameter J1. Similarly, the force between next nearest neighbors (NNN) -- that is, pairs of atoms that have at least one intervening atom between them -- is denoted by J2. Letting this batch of atoms interact among themselves, even on a pretend lattice as small as this, entails an immense calculation. Varney and his colleagues have calculated what happens in an array of hexagons consisting of 30 sites where the spins are free to swing about in a two-dimensional plane (this kind of approach is called an XY model).

Christopher Varney, who has appointments at Maryland and Georgetown, said that the interactions of atoms can be represented by a matrix (essentially a two-dimensional spreadsheet) with 155 million entries on each side. This huge number corresponds to the different spin configurations that can occur on this honeycomb-structured material.

What the researchers found were a "kaleidoscope" of phases, which represent the lowest-energy states that are allowed given the magnetic interactions. Just as water can exist in different phases -- steam, liquid, and ice -- as the temperature is changed, so here a change in the strengths of the interactions among the spins (the J1 and J2 parameters) results in different phases. For example, one simple solution is an antiferromagnet (upper picture in figure).

But one phase turns out to be a true quantum spin liquid having no order at all. When J2 is between about 21% and 36% of the value of J1, frustration coaxes the spins into disorder; the entire sample co-exists in millions of quantum states simultaneously.

It's difficult for the human mind to picture a tiny two-dimensional material in so many states at the same time. JQI fellow, Victor Galitski, suggests that one shouldn't think of the spins as residing at the original atomic sites but rather as free ranging particle-like entities dubbed "spinons." These spinons bob about, just as water molecules bob about in liquid water (see lower picture in figure). Hence the name quantum spin liquid.

Another reason for using the word liquid, Galitski says, is this 'bobbing about' is analogous to what happens inside a metal. There, the outer electrons of most atoms tend to leave their home atoms and drift through the metal sample as if they constituted a fluid, called a "Fermi liquid."

Electrons in a metal are able to drift since it takes only an infinitesimal amount of energy to put them into motion. The same is true for the fluctuating spins in the hexagonal model studied by the JQI scientists. Indeed, their spin model assumes a temperature of absolute zero, where quantum effects abound.

Writing in an essay that accompanied the article in *Physical Review Letters*, Tameem Albash and Stephan Haas, scientists at the University of Southern California, say that the JQI/Georgetown team "present a convincing example" of the new spin liquid state.

How can this new frustration calculation be tested? The experimental verification of the spin liquid state in a 2-dimenstional hexagonal lattice, Albash and Haas suggest, "will probably be tested using cold atoms trapped in optical lattices. In the past few years, this technology has become a reliable tool to emulate quantum many body lattice systems with tunable interactions." Indeed the authors propose such an experiment.

What would such a spin liquid material be good for? It's too early to tell. But some speculations include the idea that these materials could support some exotic kind of superconductivity or would organize particle-like entities that possessed fractional electric charge.

"Kaleidoscope of Exotic Quantum Phases in a Frustrated XY Model" by Christopher N. Varney, Kai Sun, Victor Galitski, and Marcos Rigol, *Physical Review Letters*, 107, 077201, (12 August 2011).

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by Joint Quantum Institute, University of Maryland.

Journal Reference:

1. Christopher Varney, Kai Sun, Victor Galitski, Marcos Rigol. Kaleidoscope of Exotic Quantum Phases in a Frustrated XY Model. *Physical Review Letters*, 2011; 107 (7) DOI: 10.1103/PhysRevLett.107.077201

http://www.sciencedaily.com/releases/2011/08/110812161813.htm

Natural brain state is primed to learn

- 19 August 2011 by Jessica Hamzelou
- Magazine issue 2826.

Oh, for a quick EEG (Image: Jamie Grill Photography/Getty)

STUDYING for an exam? Begin by thinking your way into a learning state.

Until now, neuroscientists have focused on identifying parts of the brain that are active during learning. "But no one has looked at the preparedness state," says John Gabrieli at the Massachusetts Institute of Technology. "The idea is to identify before the event whether the brain is prepared to be a learner."

Gabrieli and his colleagues used functional MRI scanning to monitor the naturally fluctuating brain activity of 20 volunteers and investigate whether the brain enters such a learning state. While in the scanner, each person was presented with 250 images, one at a time, and asked to memorise them. The volunteers were shown the images again 2 hours later - mixed in with 250 new ones - and asked to remember which they had seen before.

Looking through the results, the team was surprised to find that in the moments before individuals were shown images that they later remembered, they had low levels of activity in the parahippocampal place area - a region of the brain that is known to be highly active during learning. "Maybe the fact that this region was less active meant that the deck was cleared - that it was more open for a stimulus to provoke a response," suggests Gabrieli.

To investigate further, the team attempted to boost subsequent participants' memory test scores by presenting them with images only when they showed this pattern of brain activity. "There was around a 30 per cent improvement in the memory task," Gabrieli says (*NeuroImage*, DOI: 10.1016/j.neuroimage.2011.07.063).

The MIT team is now working on a way to monitor this "preparedness to learn" using electroencephalography (EEG) - a more portable and much cheaper brain-monitoring technique. Gabrieli's idea is to make learning more efficient by selectively teaching the prepared brain. "You could imagine a computer-based learning system which would stop when the brain is not prepared to learn and restart when it is," he says.

Leonardo Cohen, at the US National Institutes of Health in Bethesda, Maryland, who was not involved in the study, thinks the next step should instead be to use the existing scanning method to train individuals to enter good brain states of their own accord, by rewarding them when they do. "Optimising these brain regions would provide a more sophisticated way of approaching a learning task," says Cohen. "It's a very exciting idea."

A third approach would be to find a way of stimulating the same pattern in a person's brain. It has already been shown that brain stimulation using electric currents can boost a number of cognitive functions (see "Apply the electrodes..."). Could it help make us better learners, too?

"Combining brain stimulation with Gabrieli's approach could take performance to the next level," says Cohen. He suggests training an individual once they have entered the preparedness state, and then stimulating areas of the brain known to be involved in memory consolidation to cement the learning process: perhaps the ultimate in brain optimisation.

Apply the electrodes...

Externally modulating the brain's activity can boost its performance.

The easiest way to manipulate the brain is through transcranial direct current stimulation (tDCS), which involves applying electrodes directly to the head to influence neuron activity with an electric current.

Roi Cohen Kadosh's team at the University of Oxford showed last year that targeting tDCS at the brain's right parietal lobe can boost a person's arithmetic ability - the effects were still apparent six months after the tDCS session (newscientist.com/article/dn19679).

More recently, Richard Chi and Allan Snyder at the University of Sydney, Australia, demonstrated that tDCS can improve a person's insight. The pair applied tDCS to volunteers' anterior frontal lobes - regions known to play a role in how we perceive the world - and found the participants were three times as likely as normal to complete a problem-solving task (newscientist.com/article/dn20080).

Brain stimulation can also boost a person's learning abilities, according to Agnes Flöel's team at the University of Münster in Germany. Twenty minutes of tDCS to a part of the brain called the left perisylvian area was enough to speed up and improve language learning in a group of 19 volunteers (*Journal of Cognitive Neuroscience*, DOI: 10.1162/jocn.2008.20098).

Using the same technique to stimulate the brain's motor cortex, meanwhile, can enhance a person's ability to learn a movement-based skill (*Proceedings of the National Academy of Sciences*, DOI: 10.1073/pnas.0805413106).

http://www.newscientist.com/article/mg21128264.300-natural-brain-state-is-primed-to-learn.html?full=true&print=true

Biodiversity Key to Earth's Life-Support Functions in a Changing World

Meadows with different amounts of species were planted in the tracts and compared with each other. (Credit: Sandra Weigelt)

ScienceDaily (Aug. 14, 2011) — The biological diversity of organisms on Earth is not just something we enjoy when taking a walk through a blossoming meadow in spring; it is also the basis for countless products and services provided by nature, including food, building materials, and medicines as well as the self-purifying qualities of water and protection against erosion. These so-called ecosystem services are what makes Earth inhabitable for humans. They are based on ecological processes, such as photosynthesis, the production of biomass, or nutrient cycles.

Since biodiversity is on the decline, both on a global and a local scale, researchers are asking the question as to what role the diversity of organisms plays in maintaining these ecological processes and thus in providing the ecosystem's vital products and services.

In an international research group led by Prof. Dr. Michel Loreau from Canada, ecologists from ten different universities and research institutes, including Prof. Dr. Michael Scherer-Lorenzen from the University of Freiburg, compiled findings from numerous biodiversity experiments and reanalyzed them. These experiments simulated the loss of plant species and attempted to determine the consequences for the functioning of ecosystems, most of them coming to the conclusion that a higher level of biodiversity is accompanied by an increase in ecosystem processes. However, the findings were always only valid for a certain combination of environmental conditions present at the locations at which the experiments were conducted and for a limited range of ecosystem processes.

In a study published in the current issue of the journal *Nature*, the research group investigated the extent to which the positive effects of diversity still apply under changing environmental conditions and when a

multitude of processes are taken into account. They found that 84 percent of the 147 plant species included in the experiments promoted ecological processes in at least one case.

The more years, locations, ecosystem processes, and scenarios of global change -- such as global warming or land use intensity -- the experiments took into account, the more plant species were necessary to guarantee the functioning of the ecosystems. Moreover, other species were always necessary to keep the ecosystem processes running under the different combinations of influencing factors.

These findings indicate that much more biodiversity is necessary to keep ecosystems functioning in a world that is changing ever faster. The protection of diversity is thus a crucial factor in maintaining Earth's life-support functions.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by Albert-Ludwigs-Universität Freiburg.

Journal Reference:

1. Forest Isbell, Vincent Calcagno, Andy Hector, John Connolly, W. Stanley Harpole, Peter B. Reich, Michael Scherer-Lorenzen, Bernhard Schmid, David Tilman, Jasper van Ruijven, Alexandra Weigelt, Brian J. Wilsey, Erika S. Zavaleta, Michel Loreau. High plant diversity is needed to maintain ecosystem services. *Nature*, 2011; DOI: 10.1038/nature10282

http://www.sciencedaily.com/releases/2011/08/110811084513.htm

Future funerals: What a way to go

- 17 August 2011 by Helen Knight
- Magazine issue 2825.

Urban overcrowding isn't just a problem for the living (Image: Alexandra Boulat/VII/Corbis)

Ashes to ashes, gloop to frost: undertakers are devising ingenious new ways to solve an age-old problem

IN AN out-of-the-way corner of a cemetery in east London, the graves are being dug up. Bodies are lifted out of their coffins, placed in hessian bags and lowered into a communal grave nearby. Once full - it can take 80 corpses - it will be covered over and a new one opened. This may seem a harsh way to deal with the remains of people laid to rest less than a century ago, but there is no space left for new graves. If this popular graveyard is to remain open, the only solution is to reuse old plots. So they are unearthing bodies at a rate of about 10 per week. So far, over 300 have been moved, and another 1000 graves are earmarked for reuse.

With over half of the world's population living in cities, lack of space is a growing problem in urban cemeteries. Cremation cannot be the solution. For one thing, it already far outnumbers burials in some of the most overcrowded countries, including the UK and Japan. What's more, while cremations are on the increase in the US and other countries, many people still want to have their remains buried. Besides, cremation has problems of its own, not least that it consumes large amounts of energy and releases greenhouse gases and toxic emissions. So while few of us give a thought to what will happen to our bodies after we die, some people are starting - if you'll pardon the pun - to think outside the box. The reuse of grave plots is a simple solution. Others are more radical. In a field not noted for innovation, our 21st-century exit strategies are set to get creative.

Although recycling old graves will inevitably seem macabre to some, in fact it has a long history. In continental Europe the practice has been going on since the introduction of a Napoleonic law two centuries ago. In some European countries burial plots are guaranteed for as little as 20 years, after which the remains are dug up and the space freed for someone else. In the UK, however, the reuse of graves older than 75 years in London has been legal only since 2007, and even then cultural sensitivities prevented it actually happening until 2009. "There appears to be a sentiment in Britain that grave reuse is disrespectful to the dead," says Hannah Rumble at the Centre for Death and Life Studies at the University of Durham, UK. Yet British attitudes towards reburial are more liberal than some. In the US it is not practised at all. Instead, pathways and roads in New York cemeteries have been narrowed and even closed off to squeeze coffins into every available

patch of land. "Until we change our cultural mindset, we will always have a lack of burial space," says Rumble. "Grave reuse is a sustainable way forward."

But a lack of space is not the only problem. Primped cemetery grounds are often awash with pesticides, and the use of formaldehyde in embalming releases carcinogenic chemicals, too. It was the realisation that a traditional burial is far from green that led Ken West, a former manager of Carlisle Cemetery in the UK, to pioneer "natural burial" in the 1990s. It entails interring the unembalmed corpse within a simple cardboard or willow coffin in a shallow grave to ensure it decomposes naturally and quickly. If a headstone is used at all, it is a rock or piece of rough-cut limestone placed flat on the ground. Often just a tree marks the spot, and sometimes GPS coordinates are the only way to identify the grave's location. Once a natural burial site is full the land either becomes a conservation area or managed woodland, or is returned to its previous use as grazing land.

Today there are over 200 natural burial sites in the UK and they are also springing up in the US, Canada and Australia. Critics sometimes complain that the rural location of sites means bereaved families must drive a considerable distance to visit, leading to greenhouse gas emissions. Rosie Inman-Cook, manager of the Natural Death Centre in Winchester, UK, defends their green credentials. "A family who have had a natural burial 40 miles away are only likely to attend the site once a year on anniversaries, for example, because there is nothing there to tend," she says, pointing out that people often cover a much greater distance than that visiting local graveyards.

Making a splash

The idea of fading into the landscape may appeal to some, but others will want to make more of a statement in the hereafter. The US company Eternal Reefs can help. Based in Decatur, Georgia, it offers to encapsulate your cremated remains within a concrete ball. This can be decorated and customised by your family before being lowered into a coral reef, either off the coast of Florida or South Carolina, or in Chesapeake bay. The balls are up to 1.8 metres in diameter and help to support the existing reef structure and encourage growth of more coral and microorganisms, creating new habitats for fish and bivalves such as mussels and oysters. "[The augmented reefs] are there for recreational diving and fishing, and in both cases they help to take pressure off the natural reef," says George Frankel of Eternal Reefs.

It is not a cheap place to finish up, though, adding between $3000 and $7000 to the cost of a cremation that would normally come in at around $1600. However, you can rest in peace knowing that you have done your bit for the environment. "States in the US buy reef balls on a commercial basis for their fisheries management programmes," says Frankel. "So we like to say that we're building public reefs with private money."

Of course, reef burial still requires a cremation. An average cremation consumes around 35 kilowatt-hours of electricity and releases some 400 kilograms of carbon dioxide into the atmosphere, according to the Natural Death Centre. Then there are the toxic mercury emissions - a growing problem as more and more people are dying with their own teeth, and the mercury-containing fillings therein, intact. There are moves afoot to make traditional cremations more environmentally friendly (see "Combust, refine, recycle"), but a few pioneering companies have started to rethink the whole process.

Sign up for alkaline hydrolysis, for example, and your corpse will be liquefied rather than burned. The body is placed in a pressurised chamber, which is then filled with water and potassium hydroxide. After heating at 180 °C for about 3 hours, all that remains is softened bones ready to be crushed up, and a sterile, light brown soup of amino acids and peptides. This liquid contains no DNA and can be safely disposed of down the drain, or used as a fertiliser. The developer of the system, Resomation, based in Glasgow, UK, has already installed one "Resomator" at the Anderson-McQueen Funeral Home in St Petersburg, Florida. It should be up and running by September. Another unit awaits installation at a funeral home in Canada, and the company has further orders in the pipeline, according to managing director Sandy Sullivan.

Sullivan cannot confirm the cost of alkaline hydrolysis, as this will be determined by the funeral company offering the service, but he says it is likely to be similar to a conventional cremation in the UK. That typically costs about £2500 ($4000), including the service and flowers - more expensive than the average cremation in the US, but still cheaper than a typical burial, which costs at least $7000. What's more, the overall carbon footprint of alkaline hydrolysis is 34 per cent lower than that of cremation, according to carbon-accounting firm Sustain, based in Bristol, UK. "With the public becoming increasingly concerned about the environment, this allows people to express that concern in their final act on the planet," says Sullivan.

Addressing the same concerns in a different way, other innovators have turned to freeze-drying. Swedish company Promessa Organic, led by Susanne Wiighäsak, has developed a process in which the corpse is first frozen in liquid nitrogen and then vibrated to break it down into a powder. The powder is then heated under pressure in a vacuum chamber so that the water evaporates off at a low temperature. Next, a detector of the type used in the food industry uses magnetic fields to seek out any metals and mercury, which are removed. The remains, once powdered and purified in this way, can be buried in a corn-starch coffin in a shallow grave, where they will turn to compost within a year. "This really gives people the chance to become soil again," says Wiigh-Mäsak. "It means death is not the end, but the beginning of new life in the soil." The company is hoping to build its first facility in Sweden by the end of 2012.

Taking a similar approach, Cryomation, based in Woodbridge, UK, plans to freeze corpses to -196 °C in liquid nitrogen, before drying them in a vacuum. Working with researchers at the University of Hertfordshire in Hatfield, and several commercial partners, Cryomation has built a prototype device and plans to begin testing it on human bodies later this year. "There does seem to be a genuine interest in a third choice [to burial and cremation]," says Cryomation's Richard Maclean. "We are not trying to replace anything, but to offer an alternative that is better for the environment." He points out that composting the freeze-dried remains creates no atmospheric emissions. A recent study for the UK's Carbon Trust that took into account the energy used in producing the liquid nitrogen found that the process's carbon footprint is just one-third of that generated by a cremation.

Of course, it is one thing to come up with a new, greener form of burial, but quite another to persuade people to adopt it. For many, the choice of what happens to their body after they die ultimately comes down to cultural beliefs and instinctive preferences. Maclean is fully aware of this. However, he believes freeze-drying has intrinsic appeal. "My colleagues and I have stated in our wills that we wish to go this way," he says. "For me, the idea of chilling out in liquid nitrogen seems a very peaceful way to go."

Combust, refine, recycle

In many countries cremation is more popular than burial. That may save on grave plots, but it has other environmental impacts. In the UK, three-quarters of people that die are cremated - amounting to 414,000 people in 2010. A busy, well-managed crematorium uses about 35 cubic metres of natural gas to incinerate a body at close to 800 °C, releasing some 400 kilograms of carbon dioxide. Then there's the toxic mercury from dental fillings: British crematoria produce 1.34 tonnes of mercury emissions a year, accounting for almost 16 per cent of the nation's total. Cutting this could make cremation altogether greener.

In 2003, the UK and the 14 other European countries signed an OSPAR Commission recommendation in which they committed to reduce mercury emissions from crematoria by 50 per cent by 2012, and 100 per cent by 2020. To meet this commitment, crematoria have begun installing mercury-capturing filters. These use cold water to cool the exhaust from the cremation chamber down to 140 °C, before passing it through a filter to remove the mercury. A by-product of the process is uncontaminated hot water, so some crematoria are looking at ways to reuse this, including heating buildings and producing electricity.

One idea, announced by Redditch Borough Council in the UK earlier this year, is to use waste heat from the town's crematorium to heat a nearby swimming pool. Some commentators found it unpalatable. "Whenever

you are dealing with dead bodies, there will always be people who don't like what you are doing, and that's fine," says John Troyer of the Centre for Death and Society at the University of Bath, UK. In fact, most of the heat will come from combusting the fuel rather than the body. The 280 kilowatt-hours of heat energy captured from the crematorium will meet nearly half the pool's heating needs, reducing its greenhouse gas emissions by 104 tonnes each year, or around 5 per cent of the council's carbon footprint. What's more, the scheme will free up £14,500 per year that the council can use for other services.

Such benefits can help people reassess their gut reaction to schemes like these, says Troyer, who is working with the Haycombe Cemetery and Crematorium in Bath to improve its heat-capture technologies. "When such a story first breaks, the opening salvo is always from one or two people in moral outrage, but by the end of the week it has usually come full circle, with people saying this is actually a very good idea."

Helen Knight is a freelance writer based in London

http://www.newscientist.com/article/mg21128251.600-future-funerals-what-a-way-to-go.html?

Arctic Ice Melt Could Pause for Several Years, Then Resume Again

Sea ice off the Alaskan coast. (Credit: © UCAR, photo by Carlye Calvin)

ScienceDaily (Aug. 12, 2011) — Although Arctic sea ice appears fated to melt away as the climate continues to warm, the ice may temporarily stabilize or somewhat expand at times over the next few decades, new research indicates.

The computer modeling study, by scientists at the National Center for Atmospheric Research, reinforces previous findings by other research teams that the level of Arctic sea ice loss observed in recent decades cannot be explained by natural causes alone, and that the ice will eventually disappear during summer if climate change continues.

But in an unexpected new result, the NCAR research team found that Arctic ice under current climate conditions is as likely to expand as it is to contract for periods of up to about a decade.

"One of the results that surprised us all was the number of computer simulations that indicated a temporary halt to the loss of the ice," says NCAR scientist Jennifer Kay, the lead author. "The computer simulations suggest that we could see a 10-year period of stable ice or even a slight increase in the extent of the ice. Even though the observed ice loss has accelerated over the last decade, the fate of sea ice over the next decade depends not only on human activity but also on climate variability that cannot be predicted."

Kay explains that variations in atmospheric conditions such as wind patterns could, for example, temporarily halt the sea ice loss. Still, the ultimate fate of the ice in a warming world is clear.

"When you start looking at longer-term trends, 50 or 60 years, there's no escaping the loss of ice in the summer," Kay says.

Kay and her colleagues also ran computer simulations to answer a fundamental question: why did Arctic sea ice melt far more rapidly in the late 20th century than projected by computer models? By analyzing multiple realizations of the 20th century from a single climate model, they attribute approximately half the observed decline to human emissions of greenhouse gases, and the other half to climate variability.

These findings point to climate change and variability working together equally to accelerate the observed sea ice loss during the late 20th century.

The study appears this week in *Geophysical Research Letters*. It was funded by the National Science Foundation, NCAR's sponsor.

Rapid melt

Since accurate satellite measurements became available in 1979, the extent of summertime Arctic sea ice has shrunk by about one third. The ice returns each winter, but the extent shrank to a record low in September 2007 and is again extremely low this year, already setting a monthly record low for July. Whereas scientists warned just a few years ago that the Arctic could lose its summertime ice cover by the end of the century, some research has indicated that Arctic summers could be largely ice-free within the next several decades.

To simulate what is happening with the ice, the NCAR team used a newly updated version of one of the world's most powerful computer climate models. The software, known as the Community Climate System Model, was developed at NCAR in collaboration with scientists at multiple organizations and with funding by NSF and the Department of Energy.

The research team first evaluated whether the model was a credible tool for the study. By comparing the computer results with Arctic observations, they verified that, though the model has certain biases, it can capture observed late 20th century sea ice trends and the observed thickness and seasonal variations in the extent of the ice.

Kay and her colleagues then conducted a series of future simulations that looked at how Arctic sea ice was affected both by natural conditions and by the increased level of greenhouse gases in the atmosphere. The computer studies indicated that the year-to-year and decade-to-decade trends in the extent of sea ice are likely to fluctuate increasingly as temperatures warm and the ice thins.

"Over periods up to a decade, both positive and negative trends become more pronounced in a warming world," says NCAR scientist Marika Holland, a co-author of the study.

The simulations also indicated that Arctic sea ice is equally likely to expand or contract over short time periods under the climate conditions of the late 20th and early 21st century.

Although the Community Climate System Model simulations provide new insights, the paper cautions that more modeling studies and longer-term observations are needed to better understand the impacts of climate change and weather variability on Arctic ice.

The authors note that it is also difficult to disentangle the variability of weather systems and sea ice patterns from the ongoing impacts of human emissions of greenhouse gases.

"The changing Arctic climate is complicating matters," Kay says. "We can't measure natural variability now because, when temperatures warm and the ice thins, the ice variability changes and is not entirely natural."

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by National Center for Atmospheric Research/University Corporation for Atmospheric Research.

Journal Reference:

1. Jennifer E. Kay, Marika M. Holland, Alexandra Jahn. Inter-annual to multi-decadal Arctic sea ice extent trends in a warming world. *Geophysical Research Letters*, 2011; 38 (15) DOI: 10.1029/2011GL048008

http://www.sciencedaily.com/releases/2011/08/110811113956.htm

Warning: Killer fungi could run amok again

- 19 August 2011 by Michael Marshall
- Magazine issue 2826.

DURING Earth's biggest mass extinction 250 million years ago, usually tame soil fungi ran amok, decimating most of the world's trees. A repeat coup is possible, if climate change weakens trees too much.

The Permian extinction saw 95 per cent of species wiped out, dwarfing the K/T extinction that ended the dinosaurs' reign. According to Mark Sephton of Imperial College London, a knock-on effect of the vast volcanic eruptions that triggered the extinction was a global fungal plague.

Sephton has long been intrigued by a mysterious layer of fossilised strands in rocks that formed at the end of the Permian epoch. "You can find it all round the globe," he says, "and you don't see it anywhere else in the geological record." The strands were first thought to be opportunistic fungi that feasted on plants after they died, although some researchers thought they were algae, which couldn't have eaten the trees (*Palynology*, DOI: 10.2113/0260035).

To settle the question, Sephton teamed up with Henk Visscher of Utrecht University in the Netherlands and Cindy Looy of the University of California, Berkeley. They found that the strands looked just like a group of modern fungi called *Rhizoctonia*, implying a fungal takeover took place.

Rhizoctonia lurk in soils, waiting to attack plants whose immune systems are weakened. Sephton thinks their Permian counterparts attacked and killed trees, which would have been weakened by heat stress, drought and acidification due to the volcanic eruptions (*Geology*, DOI: 10.1130/g32178.1).

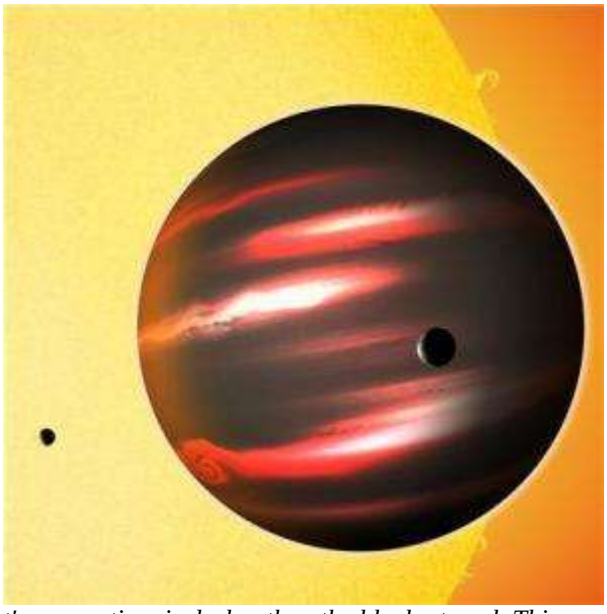
Fungi's role in the Permian extinction is a warning, says Sephton. Climate change and other human activities are stressing plants around the world, potentially putting them at risk. "Dramatic changes can occur when you stress an ecosystem too far," he says.

But it's not clear that fungi could once again run amok, says Steven Running of the University of Montana in Missoula. Most modern plant pathogens can only attack one genus, or even species, limiting the damage they can do, he says.

The closest modern-day analogue is the heavily polluted Black Triangle in eastern Europe. Acidification from Soviet-era industry killed or damaged all the trees, which were then set upon by fungi.

http://www.newscientist.com/article/mg21128265.000-warning-killer-fungi-could-run-amok-again.html

Darkest Known Exoplanet: Alien World Is Blacker Than Coal



The distant exoplanet TrES-2b, shown here in an artist's conception, is darker than the blackest coal. This Jupiter-sized world reflects less than one percent of the light that falls on it, making it blacker than any planet or moon in our solar system. Astronomers aren't sure what vapours in the planet's superheated atmosphere cloak it so effectively. (Credit: David A. Aguilar (CfA))

ScienceDaily (Aug. 12, 2011) — Astronomers have discovered the darkest known exoplanet -- a distant, Jupiter-sized gas giant known as TrES-2b. Their measurements show that TrES-2b reflects less than one percent of the sunlight falling on it, making it blacker than coal or any planet or moon in our solar system.

The new work appears in a paper in the journal *Monthly Notices of the Royal Astronomical Society*.

"TrES-2b is considerably less reflective than black acrylic paint, so it's truly an alien world," said astronomer and lead author David Kipping of the Harvard-Smithsonian Center for Astrophysics (CfA).

In our solar system, Jupiter is swathed in bright clouds of ammonia that reflect more than a third of the sunlight reaching it. In contrast, TrES-2b (which was discovered in 2006 by the Trans-Atlantic Exoplanet Survey, or TrES) lacks reflective clouds due to its high temperature.

TrES-2b orbits its star at a distance of only five million kilometres. The star's intense light heats TrES-2b to a temperature of more than 1000 degrees Celsius -- much too hot for ammonia clouds. Instead, its exotic atmosphere contains light-absorbing chemicals like vaporized sodium and potassium, or gaseous titanium oxide. Yet none of these chemicals fully explain the extreme blackness of TrES-2b.

"It's not clear what is responsible for making this planet so extraordinarily dark," stated co-author David Spiegel of Princeton University. "However, it's not completely pitch black. It's so hot that it emits a faint red glow, much like a burning ember or the coils on an electric stove."

Kipping and Spiegel determined the reflectivity of TrES-2b using data from NASA's Kepler spacecraft. Kepler is designed to measure the brightnesses of distant stars with extreme precision.

The team monitored the brightness of the TrES-2 system as the planet orbited its star. They detected a subtle dimming and brightening due to the planet's changing phase.

TrES-2b is believed to be tidally locked like our moon, so one side of the planet always faces the star. And like our moon, the planet shows changing phases as it orbits its star. This causes the total brightness of the star plus planet to vary slightly.

"By combining the impressive precision from Kepler with observations of over 50 orbits, we detected the smallest-ever change in brightness from an exoplanet: just 6 parts per million," said Kipping. "In other words, Kepler was able to directly detect visible light coming from the planet itself."

The extremely small fluctuations proved that TrES-2b is incredibly dark. A more reflective world would have shown larger brightness variations as its phase changed.

Kepler has located more than 1,200 planetary candidates in its field of view. Additional analysis will reveal whether any other unusually dark planets lurk in that data.

TrES-2b orbits the star GSC 03549-02811, which is located about 750 light-years away in the direction of the constellation Draco. (One light-year is about 10 million million kilometres.)

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by Royal Astronomical Society (RAS).

Journal Reference:

1. Kipping D. M. and Spiegel D. S. Detection of visible light from the darkest world. *Monthly Notices of the Royal Astronomical Society*, 1–5 (2011)

http://www.sciencedaily.com/releases/2011/08/110811105115.htm

Foamy wakes cool the world, ships don't

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Cooling effect, barely (Image: Robert Llewellyn/Getty)

THEY are the nautical equivalent of contrails. But the foamy wakes that ships leave behind, unlike the condensation generated by aircraft, may reduce global temperatures by reflecting sunlight. It's no reason for shipping magnates to get too excited, though: the cooling barely makes a dent in the warming effect of the massive carbon emissions attributed to shipping.

As vessels traverse the oceans, they create temporary trails of white foamy water. Using a plane carrying equipment to monitor solar radiation, Charles Gatebe and colleagues at NASA's Goddard Space Flight Center in Greenbelt, Maryland, measured the reflectivity of the wake of four ships over several kilometres. They found that the white froth reflected more than twice as much sunlight as dark, undisturbed waters.

The team used previous studies to estimate that more than 32,000 ships of 100,000 tonnes or more criss-cross the oceans at any time. Combined with their reflectivity measurements, they calculated that ships decrease the amount of solar energy absorbed by the oceans by 0.14 milliwatts per square metre (*Geophysical Research Letters*, DOI: 10.1029/2011GL048819).

Gatebe describes the cooling effect as "a drop in the ocean" compared with the amount of warming shipping emissions cause.

http://www.newscientist.com/article/mg21128265.600-foamy-wakes-cool-the-world-ships-dont.html

Research Reveals Genetic Link to Human Intelligence

New research provides the first direct biological evidence for a genetic contribution to people's intelligence. (Credit: iStockphoto/Mads Abildgaard)

ScienceDaily (Aug. 12, 2011) — University of Manchester scientists, working with colleagues in Edinburgh and Australia, have provided the first direct biological evidence for a genetic contribution to people's intelligence.

Previous studies on twins and adopted people suggested that there is a substantial genetic contribution to thinking skills, but this new study -- published in the journal *Molecular Psychiatry* -- is the first to find a genetic contribution by testing people's DNA for genetic variations.

The team studied two types of intelligence in more than 3,500 people from Edinburgh, Aberdeen, Newcastle and Manchester. The paper, by Dr Neil Pendleton and colleagues, found that 40% to 50% of people's differences in these abilities could be traced to genetic differences.

The study examined more than half a million genetic markers on every person in the study. The new findings were made possible using a new type of analysis invented by Professor Peter Visscher and colleagues in Brisbane. As well as the findings in people from Scotland and England, the team checked their results in a separate group of people from Norway.

Dr Pendleton, who led the Manchester team in the Centre for Integrated Genomic Research, said: "This is the first reported research to examine the intelligence of healthy older adults and, using a comprehensive genetic survey, we were able to show a substantial genetic contribution in our ability to think.

"The study confirms the earlier findings of the research in twins. However, that research could not show which genes were or were not contributing to cognitive ability. Our work demonstrates that the number of individual genes involved in intelligence is large, which is similar to other human traits, such as height.

"We can now use the findings to better understand how these genes interact with each other and the environment, which has an equally significant contribution. With our collaborators, we will take this work

forward to find the biological mechanisms that could maintain our intellectual abilities and wellbeing in late life. "

The study, in collaboration with Professor Ian Deary at the University of Edinburgh, was funded in Manchester by the Biotechnology and Biological Sciences Research Council.

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

Journal Reference:

1. G Davies, A Tenesa, A Payton, J Yang, S E Harris, D Liewald, X Ke, S Le Hellard, A Christoforou, M Luciano, K McGhee, L Lopez, A J Gow, J Corley, P Redmond, H C Fox, P Haggarty, L J Whalley, G McNeill, M E Goddard, T Espeseth, A J Lundervold, I Reinvang, A Pickles, V M Steen, W Ollier, D J Porteous, M Horan, J M Starr, N Pendleton, P M Visscher, I J Deary. Genome-wide association studies establish that human intelligence is highly heritable and polygenic. *Molecular Psychiatry*, 2011; DOI: 10.1038/mp.2011.85

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The end of the road for motormania

- 16 August 2011 by Fred Pearce
- Magazine issue 2825

The interchange is changing (Image: John Humble/Getty)

Something unexpected is happening to our car-crazy culture. What are the forces driving us out of motoring?

IS THE west falling out of love with the car? For environmentalists it seems an impossible dream, but it is happening. While baby boomers and those with young families may stick with four wheels, a combination of our ageing societies and a new zeitgeist among the young seems to be breaking our 20th-century car addiction. Somewhere along the road, we reached "peak car" and are now cruising down the other side.

Peak car takes several forms. Sales of new cars have almost halved in the US, down from nearly 11 million in 1985 to about 5.5 million in 2009. We shouldn't take much notice of that, though. Cars last longer these days, and sales go up and down with the economy. But we have hit peak car ownership, too. And, more to the point, peak per-capita travel.

The phenomenon was first recognised in *The Road... Less Traveled*, a 2008 report by the Brookings Institution in Washington DC, but had been going on largely unnoticed for years.

Japan peaked in the 1990s. They talk there of "demotorisation". The west had its tipping point in 2004. That year the US, UK, Germany, France, Australia and Sweden all saw the start of a decline in the number of kilometres the average person travelled in a car that continues today. In Australia, car travel peaked in every city in 2004 and has been falling since (*World Transport Policy and Practice*, vol 17, p 31). It is a similar picture in the UK, where per-capita car travel is down 5 per cent since 2004.

What could be driving us off the road? Fuel costs and rising insurance premiums may be a factor. And urban gridlock, combined with an absence of parking places and congestion charging, makes the car a dumb way to move around in cities where there are public transport alternatives.

In the US, however, the decline of the car is most dramatic not in the gridlocked city centres but in the car-dependent suburbs. In sprawling cities like Atlanta and Houston where the automobile is king, driving is down by more than 10 per cent.

Of course the end of the love affair with the car may just be a sign of the economic times: the much-discussed "hollowing out" of the middle classes, with jobs available at the top and bottom of society, but less so for the white-collar workers. Still, a study by Lee Schipper of the Global Metropolitan Studies unit at the University of California, Berkeley, found that while rising wealth correlates with more travel up to a per-capita income of $30,000, beyond that the link breaks down (*Transport Reviews*, vol 31, p 357).

Demographics is a more likely explanation. It is surely no accident that peak car happened first in Japan, which has the world's oldest population. Pensioners do not drive to work, and many don't drive at all. There is also the rise of people like me, "virtual commuters" who work from home via the internet.

Besides work habits, leisure lifestyles are also changing. The biggest fall in car use in the US is among people under 35. The fraction of American 17-year-olds with a driver's licence has fallen from about three-quarters to about half since 1998. Twenty-somethings have recently gone from driving more than the average to driving less.Social scientists detect a new "culture of urbanism". The stylish way to live these days is in inner-city apartments. The suburbs suck. Richard Florida, an urban studies theorist at the University of Toronto in Canada, points out that the young shop online, telecommute, live in walkable city neighbourhoods near public transport and rely more on social media and less on face-to-face visiting. Given those changes, they can think of better ways to spend their money than buying a car.

Phil Goodwin at the University of the West of England in Bristol says the same applies to the UK, where young people are the most prominent in dropping out of the great car society. Maurie Cohen, an environmental scientist at the New Jersey Institute of Technology in Newark, says "Gen Y-ers are quite cool to the automobile." The modern James Dean is a rebel without a car.Meanwhile, use of everything else, from bikes and buses to trains and trams, is still going up. But even that trend may reverse. Schipper says we may be approaching a point of "peak travel" of all sorts. People just won't see the need to move around so much.

Of course, environmentalists shouldn't get carried away. In the developing world, the car boom is only now getting under way, despite gridlock in cities from Shanghai to São Paulo. That trend makes any claim of an impending global peak car far-fetched.

The industrialised world still has plenty of less-green trends too. Falling car occupancy is one. In the US, the average car on the average journey carries 1.7 people, half a person less than in 1970. So even if we individually travel less, our cars may travel just as much. Likewise, the continuing trend for bigger and more powerful cars is wiping out the gains from more fuel-efficient vehicles. And sometimes we simply replace driving with flying.But the good news is that those straight lines on the planners' graphs predicting ever rising car-kilometres and ever-worsening carbon emissions from internal combustion engines are being proved wrong.

Planners need to take note. And, if they have any sense, they will start to reinforce these trends with improved public transport, an end to urban sprawl and more investment in inner cities.

Some think car use will revive if and when economies recover. But it looks like something more profound is going on. Florida calls it a "great reset" in society that will have profound consequences - not least for the environment. Even our most treasured consumer aspirations can have a peak. Enough can be enough.

Fred Pearce is New Scientist's environment consultant

http://www.newscientist.com/article/mg21128255.600-the-end-of-the-road-for-motormania.html