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Manufacturing Method Paves Way for Commercially Viable Quantum Dot-Based LEDs

Conventional LEDs. New research future suggests that future lighting needs may be supplied by a new breed of light emitting diode, or LED, that conjures light from the invisible world of quantum dots. (Credit: © taty / Fotolia)

ScienceDaily (Aug. 31, 2011) — University of Florida researchers may help resolve the public debate over our future light source of choice: Edison's incandescent bulb or the more energy efficient compact fluorescent lamp.

It could be neither.

Instead, our future lighting needs may be supplied by a new breed of light emitting diode, or LED, that conjures light from the invisible world of quantum dots. According to an article in the current online issue of the journal *Nature Photonics*, moving a QD LED from the lab to market is a step closer to reality thanks to a new manufacturing process pioneered by two research teams in UF's department of materials science and engineering.

"Our work paves the way to manufacture efficient and stable quantum dot-based LEDs with really low cost, which is very important if we want to see wide-spread commercial use of these LEDs in large-area, full-color flat-panel displays or as solid-state lighting sources to replace the existing incandescent and fluorescent lights," said Jiangeng Xue, the research leader and an associate professor of material science and engineering "Manufacturing costs will be significantly reduced for these solution-processed devices, compared to the conventional way of making semiconductor LED devices."

A significant part of the research carried out by Xue's team focused on improving existing organic LEDs. These semiconductors are multilayered structures made up of paper thin organic materials, such as polymer plastics, used to light up display systems in computer monitors, television screens, as well as smaller devices such as MP3 players, mobile phones, watches, and other handheld electronic devices. OLEDs are also becoming more popular with manufacturers because they use less power and generate crisper, brighter images than those produced by conventional LCDs (liquid crystal displays). Ultra-thin OLED panels are also used as replacements for traditional light bulbs and may be the next big thing in 3-D imaging.

Complementing Xue's team is another headed by Paul Holloway, distinguished professor of materials science and engineering at UF, which delved into quantum dots, or QDs. These nano-particles are tiny crystals just a few nanometers (billionths of a meter) wide, composed of a combination of sulfur, zinc, selenium and cadmium atoms. When excited by electricity, QDs emit an array of colored light. The individual colors vary depending on the size of the dots. Tuning, or "adjusting," the colors is achieved by controlling the size of the QDs during the synthetic process.

By integrating the work of both teams, researchers created a high-performance hybrid LED, composed of both organic and QD-based layers. Until recently, however, engineers at UF and elsewhere have been vexed by a manufacturing problem that hindered commercial development. An industrial process known as vacuum deposition is the common way to put the necessary organic molecules in place to carry electricity into the QDs. However, a different manufacturing process called spin-coating, is used to create a very thin layer of QDs. Having to use two separate processes slows down production and drives up manufacturing costs.

According to the Nature Photonics article, UF researchers overcame this obstacle with a patented device structure that allows for depositing all the particles and molecules needed onto the LED entirely with spin-coating. Such a device structure also yields significantly improved device efficiency and lifetime compared to previously reported QD-based LED devices.

Spin-coating may not be the final manufacturing solution, however.

"In terms of actual product manufacturing, there are many other high through-put, continuous "roll-to-roll" printing or coating processes that we could use to fabricate large area displays or lighting devices," Xue said. "That will remain as a future research and development topic for the university and a start-up company, NanoPhotonica, that has licensed the technology and is in the midst of a technology development program to capitalize on the manufacturing breakthrough."

Other co-authors of this article are Lei Qian and Ying Zheng, two postdoctoral fellows who worked with the professors on this research. The UF research teams received funding from the Army Research Office, the U.S. Department of Energy, and the Florida Energy Systems Consortium.

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 John Dunn.

Journal Reference:

1. Lei Qian, Ying Zheng, Jiangeng Xue, Paul H. Holloway. **Stable and efficient quantum-dot light-emitting diodes based on solution-processed multilayer structures**. *Nature Photonics*, 2011; 5 (9): 543 DOI: 10.1038/nphoton.2011.171

http://www.sciencedaily.com/releases/2011/08/110831160222.htm

Bedrock Nitrogen May Help Forests Buffer Climate Change, Study Finds

The forests of South Fork Mountain in northern California draw nitrogen from bedrock, making them some of the state's most productive forests. Understanding and quantifying this newly identified source of nitrogen may significantly impact scientists understanding of forest productivity, carbon storage and nitrogen cycling on land. (Credit: Photo by Scott Morford/UC Davis)

ScienceDaily (Aug. 31, 2011) — For the first time, researchers at the University of California, Davis, have demonstrated that forest trees have the ability to tap into nitrogen found in rocks, boosting the trees' growth and their ability to pull more carbon dioxide from the atmosphere.

Given that carbon dioxide is the most important climate-change gas, the nitrogen in rocks could significantly affect how rapidly Earth will warm in the future, the researchers say. They report their findings in the Sept. 1 issue of the scientific journal *Nature*.

If trees can access more nitrogen than previously thought, that could lead to more storage of carbon on land and less carbon remaining in the atmosphere.

"We were really shocked; everything we've ever thought about the nitrogen cycle and all of the textbook theories have been turned on their heads by these data," said Professor Benjamin Houlton, a biogeochemist and one of the study's co-authors.

"Findings from this study suggest that our climate-change models should not only consider the importance of nitrogen from the atmosphere, but now we also have to start thinking about how rocks may affect climate change," he said.

The importance of nitrogen

Nitrogen, found in such vital molecules as DNA and protein, is necessary for all life and is used worldwide as a fertilizer for food crops. It is the nutrient that most often limits plant growth in natural ecosystems.

It was previously believed that nitrogen could only enter ecosystems from the atmosphere -- either dissolved in rainwater or biologically "fixed" or assimilated by specialized groups of plants and other organisms. Because the amount of nitrogen in these atmospheric pathways is rather limited, it was thought that most ecosystems could not get enough of this vital nutrient to facilitate plant growth at maximum rates.

Following this line of thought, it was estimated that the nitrogen contribution from rocks in Northern California was on the same order as atmospheric nitrogen sources, made available through fixation and deposited via rainwater.

"To put it in perspective, there is enough nitrogen contained in one inch of the rocks at our study site to completely support the growth of a typical coniferous forest for about 25 years," said Professor Randy Dahlgren, a biogeochemist and a study co-author.

"This nitrogen is released slowly over time and helps to maintain the long-term fertility of many California forests," Dahlgren said. "It is also interesting to consider that the nitrogen in the rocks from our study site originates from the time of the dinosaurs, when plant and animal remains were incorporated into the sediments that eventually formed the rocks."

The UC Davis findings

The UC Davis study, led by Scott Morford, a graduate student in the Department of Land, Air and Water Resources, focused on measuring the nitrogen in rocks, soils and plants, and found that rocks enriched in nitrogen have a profound effect on the fertility of forests.

Data from the study indicate that the amount of carbon stored in forest soils derived from the nitrogen-rich bedrock was nearly twice that of sites associated with nitrogen-poor rocks in Northern California. Furthermore, the researchers used the inventory of forest growth data from the National Forest Service to determine that this was not just a localized effect. In fact, the productivity of forests growing on nitrogen-rich rock was approximately 50 percent higher than the productivity of forests growing on nitrogen-poor rocks throughout Northern California and into Oregon.

"We were all stunned when the data showed that the nitrogen in the trees was extremely high in forests that were living on the rocks with high nitrogen," said Morford.

To confirm the link between the nitrogen in the trees and that in the surrounding rock, the researchers traced the nitrogen from the rocks using the different isotopes of nitrogen. They found that the nitrogen isotopes in the rock matched those of the soils and trees, confirming that the nitrogen was coming from the rocks.

"It was like a fingerprint; we found the culprit, and it was the nitrogen in the rocks," Morford said.

Implications for climate change

The researchers stress that, since nitrogen tends to be elevated in rocks of sedimentary origin, which cover roughly 75 percent of Earth's land surface, the discovery that bedrock nitrogen has the potential to stimulate forest productivity and carbon storage has tremendous global significance.

"The stunning finding that forests can also feed on nitrogen in rocks has the potential to change all projections related to climate change," said Houlton. "This discovery may also help explain several other studies that have found that the nitrogen 'budgets' of forests are out of balance, the nitrogen accumulation in their soil and plants being substantially greater than the apparent nitrogen inputs."

Houlton noted that nitrogen is becoming increasingly important in climate-change studies and researchers have begun to incorporate nitrogen in their climate-change models. Some models indicate that the nutrient could cause an additional increase in global temperatures of up to one degree Celsius (1.8 degrees Fahrenheit) by 2010, as it limits the amount of carbon dioxide that plants around the world can extract from the atmosphere. If more nitrogen is available than predicted from the traditional nitrogen-cycling pathways, as the UC Davis study suggests, it could lead to more carbon storage on land and less carbon remaining in the atmosphere.

The researchers call for further studies in other parts of the world to determine if nitrogen in rocks affects forests outside of the Pacific Northwest.

Morford is continuing his research and during the past year has collected more than 800 rocks from Oregon to San Diego. A goal of this future research is to determine how fast nitrogen is released from rocks under the varying environmental conditions in California and beyond.

This study was funded by the Andrew W. Mellon Foundation, the Packard Foundation, and the Kearney Foundation for Soil Science.

Story Source:

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

Journal Reference:

1. Scott L. Morford, Benjamin Z. Houlton, Randy A. Dahlgren. **Increased forest ecosystem carbon and nitrogen storage from nitrogen rich bedrock**. *Nature*, 2011; 477 (7362): 78 DOI: 10.1038/nature10415

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http://www.sciencedaily.com/releases/2011/08/110831155347.htm

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.

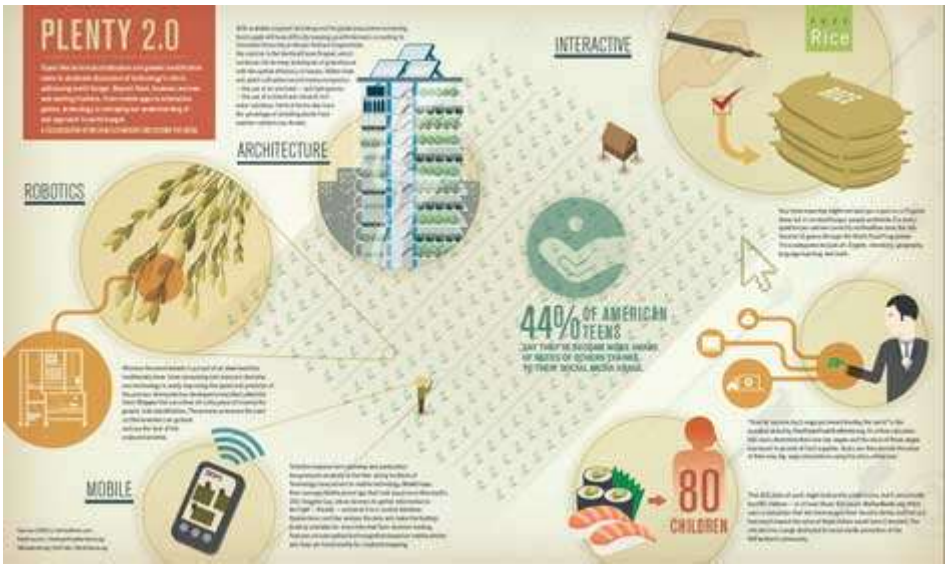
Robotics
Whereas the plant breeder's pursuit of an ideal seed has traditionally been time-consuming and resource-intensive, new technology is vastly improving the speed and precision of the process. Monsanto has developed a machine called the Corn Chipper that can shave off a tiny piece of a kernel for 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.

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

Decade-Long Study Reveals Recurring Patterns of Viruses in the Open Ocean

This image shows the deployment of a sensor for conductivity, temperature and depth-profiling rosette (CTD). The equipment was used to sample the water throughout the water column, including viruses. (Credit: Craig Carlson)

ScienceDaily (Aug. 30, 2011) — Viruses fill the ocean and have a significant effect on ocean biology, specifically marine microbiology, according to a professor of biology at UC Santa Barbara and his collaborators.

Craig A. Carlson, professor with UCSB's Department of Ecology, Evolution, and Marine Biology, is the senior author of a study of marine viruses published this week by the *International Society for Microbial Ecology Journal*, of the Nature Publishing Group.

The new findings, resulting from a decade of research, reveal striking recurring patterns of marine virioplankton dynamics in the open sea, which have implications regarding our understanding of cycling of nutrients in the world's oceans.

Marine viruses encompass enormous genetic diversity, affect biogeochemical cycling of elements, and partially control aspects of microbial production and diversity, according to the scientists. Despite their importance in the ocean, there has been a surprising lack of data describing virioplankton distributions over time and depth in open oceanic systems.

"Microbial interactions, between oceanic viruses and bacteria, take place on the nanometer scale but are extremely important in governing the flow of energy and the cycling of nutrients like carbon, nitrogen, and phosphorus on the ecosystem scale of the world's oceans," said Carlson. The scientists studied microbes in the water column of the Saragasso Sea, off of Bermuda, for a decade.

"Although we can't see them with our naked eye, marine microbes are the dominant life forms in our oceans," said Rachel J. Parsons, first author and a microbial oceanographer with the Bermuda Institute of Ocean Science. "They comprise 95 percent of the living biomass in the oceans -- more than all the krill, fish and whales put together. They grow at rates many times faster than larger animals. As a result of their sheer numbers, and the rates at which they grow, they are responsible for transforming and shaping the distribution of life's essential elements -- and they help control climate on our planet. Without marine microbes, life as we know it could not persist."

According to the scientists, there are approximately 10 million viruses in every drop of surface seawater, yet despite the high number of viruses very few are infectious agents to larger animals like fish, whales, or humans. That is because almost all of the marine viruses are "phages" -- viruses that specifically attack marine bacteria. Marine phages cannot carry out cellular metabolism and must therefore rely on the metabolic machinery of their bacterioplankton hosts to replicate. This warfare often kills the hosts, causing them to spill their internal nutrient content into the surrounding water.

In the new paper, the authors describe remarkably regular annual patterns of virioplankton abundance, tied to ocean physics and chemistry. These patterns in turn control the dynamics of the bacterioplankton hosts. The data suggest that a significant fraction of viruses in the upper photic, or light, zone of the subtropical oceanic gyres may be cyanophages -- viruses that infect photosynthetic bacterioplankton.

If true, the dominance of cyanophages in open ocean systems has significant biogeochemical implications. Viral-mediated breakdown of cyanobacteria could benefit phytoplankton through the release of macro- and micronutrients. Viral breakdown of host cells converts particulate material to suspended or dissolved materials such as amino acids and nucleic acids, effectively resulting in the retention of nitrogen, phosphorus, and iron within the surface water. These dissolved materials fuel microbial activity in an otherwise nutrient-poor open ocean system.

In this decade-long study, the scientists studied in unprecedented detail the temporal and vertical patterns of virioplankton abundance within the open ocean. Samples were collected throughout the upper 300 meters of the water column every month, beginning in the year 2000, at an open ocean hydrostation called the Bermuda Atlantic Time-series Study (BATS) site. The additional data collected as part of the BATS program provides oceanographic details regarding ocean physics, chemistry, and biology that are extremely valuable for interpreting the observed trends in marine phages.

"This high-resolution, decadal survey provides insight into the possible controls of virioplankton dynamics and the role they play in regulating biology and nutrient cycling in the open ocean," said Carlson. "The data provided by this study will now be utilized by ecosystem and biogeochemical modelers in an attempt to better understand how microbial processes affect the larger biogeochemical cycling in the ocean."

Other co-authors of the study are Mya Breitbart, of the University of South Florida, and Michael W. Lomas, of the Bermuda Institute of Ocean Science.

Story Source:

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Journal Reference:

1. Rachel J Parsons, Mya Breitbart, Michael W Lomas, Craig A Carlson. **Ocean time-series reveals recurring seasonal patterns of virioplankton dynamics in the northwestern Sargasso Sea**. *The ISME Journal*, 2011; DOI: 10.1038/ismej.2011.101

http://www.sciencedaily.com/releases/2011/08/110811133130.htm

Ironworkers of the Sky

By RANDY KENNEDY

"You need to have a very unique trait inside, to go running out on the iron," says Kevin Sabbagh, 24, a fifth-generation ironworker known as Woogie.

To get to the top of 1 World Trade Center as it stands in mid-August, just shy of 1,000 feet above Lower Manhattan, higher than anything else on the island's southern end, first you walk to the middle of the blast-resistant concrete cathedral that will become the building's lobby. From there, a hoist takes you to the 39th floor, whose perimeter has already been glassed in. A sign spray-painted in screaming construction orange — "EXPRESS ALL DAY" — directs you to a second hoist, inside which Don McLean is singing, "Bye, bye, Miss American Pie . . ." and men in hard hats decoupaged with flag decals are bobbing their heads to the beat.

On the 70th floor, the end of the line for the hoist, you emerge and climb five more stories inside a cage staircase attached to the outside of the building's south face before taking a final flight of stairs. At the top of these you see — disconcertingly, even though you have known where you were heading all along — brilliant sunshine. Above you is blue sky and two floors of skeletal steel not yet covered in decking. The only other thing overhead, on the bare beams, is the remarkably small tripartite crew of workers doing jobs that have remained virtually unchanged since steel-frame construction began a little more than a century ago: guiding the steel into place as the cranes lift it up (the raising gang), securing it permanently (the bolting gang) and ensuring that all of it is vertically true (the plumb-up gang).

It is like arriving at one of Earth's extremities — the Tibetan plateau, the Antipodes — except that you somehow feel as if you have been here before. And in a sense you have, because this scene is deeply embedded in the image bank of the 20th and 21st centuries. In fact, it sometimes seems as if the very existence of the men who build skylines by hand has been inextricably linked to the existence of the men (they have mostly been men) who have photographed them — first lugging their wooden view cameras, with tripods and dark cloths, then their Speed Graphics and Leicas — to the places where steel meets sky, giving flesh and bone to ironworkers who otherwise would have been phantoms of progress, risking their lives, unseen, hundreds of feet above the city.

The names of many of the photographers, working for newspapers or construction companies, have been forgotten. But some were titans: Lewis Hine, who applied his compassion for the working class to the builders of the Empire State Building; Bruce Davidson, who poetically chronicled the construction of the Verrazano-Narrows Bridge.

The lure of ironworking imagery is, in part, formal: the complex geometry of straight lines and sharp diagonals against the almost classically curved human forms of arms, legs and backs. But the affinities between ironworkers and photographers themselves run deep. Both professions are defined by the compulsion to go where most people won't go and see with their own eyes what most people will never see. The sentiment of Ethan Kitzes, a 41-year-old ironworker at 1 World Trade, could apply just as well to Robert Capa on Omaha Beach in 1944 or Frank Hurley adrift on an Antarctic ice floe with Shackleton in 1915: "There is no dress rehearsal."

In July, The New York Times Magazine assigned Damon Winter, a Pulitzer Prize-winning photographer for the newspaper, to spend five days alongside workers like Kitzes, who was among the first wave of volunteers on Sept. 12, 2001, brought in to extract steel from the ruins of the twin towers and who has returned to the site as a member of the plumb-up gang.

Even among the elite class of ironworkers that specializes in raising high steel, the 40 or so men who perform the most dangerous work at 1 World Trade are a kind of special forces. There are veterans like Turhan Clause, a 46-year-old bolter-upper and an Algonquin Indian whose father and grandfather were also in the trade. And members of the next generation like Jim Brady, 29, an astonishingly agile connector who grabs the steel with gloved hands and sets it in place, shinnying beams without a harness. Brady's broad face itself seems to sustain the immense weight of the Trade Center site's past and express the perseverance that has powered the rise of a new tower — a structure whose symbolic importance is undisputed even if its cost and commercial justification remain dubious.

Neither Brady nor his colleagues are very good at doing what photographers do for them: standing outside themselves to articulate the almost Romantic-era daring of their job in a world of increasingly bloodless, prefab industry. But Christopher Marron, a 39-year-old first-year apprentice ironworker who once worked on the floor of the New York Stock Exchange (he was there the morning of 9/11), seems to speak plainly for them all: "I look forward to getting here. I look forward to working my ass off. I look forward to sweating. And I look forward to finishing this building. I plan on staying all the way to the top."

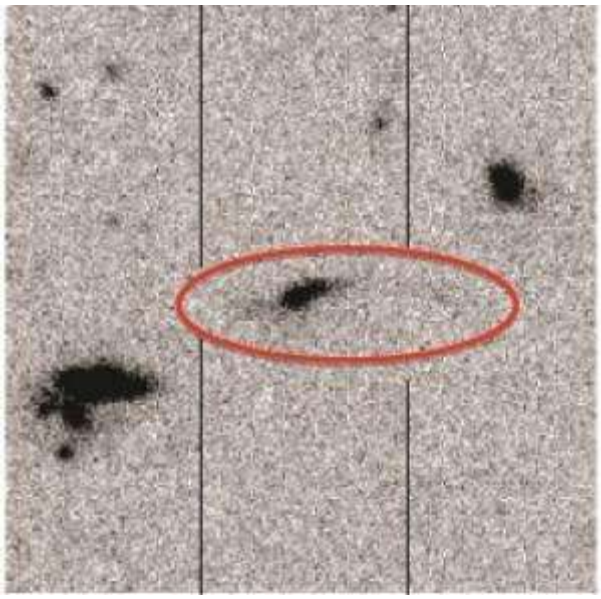
Additional reporting by Pamela Chen.

Damon Winter (damonw@nytimes.com) is a staff photographer for The New York Times. He won a Pulitzer Prize in 2009 for his coverage of the Obama presidential campaign.

Editor: Joanna Milter (j.milter-MagGroup@nytimes.com)

http://www.nytimes.com/2011/09/04/us/sept-11-reckoning/04Mag-ironworkers.html?_r=1&ref=magazine

Discovery Sheds Light On the Ecosystem of Young Galaxies



An image of the galaxy LDSS3 (within the red ellipse) from the Hubble Space telescope archive, that shows that the underlying galaxy is highly distorted, with extended stellar tails to the left and right. (Credit: Michael Rauch / Carnegie Institution for Science / STScI)

ScienceDaily (Aug. 30, 2011) — A team of scientists, led by Michael Rauch from the Carnegie Observatories, has discovered a distant galaxy that may help elucidate two fundamental questions of galaxy formation: How galaxies take in matter and how they give off energetic radiation.

Their work will be published in the *Monthly Notices of the Royal Astronomical Society*.

During the epoch when the first galaxies formed, it is believed that they radiated energy, which hit surrounding neutral hydrogen atoms and excited them to the point where they were stripped of electrons. This produced the ionized plasma that today fills the universe. But little is known about how this high-energy light was able to escape from the immediate surroundings of a galaxy, known as the galactic halo. The galaxies we observe today tend to be completely surrounded by gaseous halos of neutral hydrogen, which absorb all light capable of ionizing hydrogen before it has a chance to escape.

Rauch and his team, using the Magellan Telescopes at Las Campanas Observatory and archival images from the Hubble Space Telescope, discovered a galaxy with an extended patch of light surrounding it. The objects appearance means that roughly half of the galaxy's radiation must be escaping and exciting hydrogen atoms outside of its halo.

The key to the escape of radiation can be found in the unusual, distorted shape of the newly observed galaxy. It appears that the object had recently been hit by another galaxy, creating a hole in its halo, allowing radiation to pass through.

"The loss of radiation during galactic interactions and collisions like the one seen here may be able to account for the re-ionization of the universe," Rauch said. "This galaxy is a leftover from a population of once-numerous dwarf galaxies. And looking back to a time when the universe was more dense, crashes between galaxies would have been much more common than today."

The new observation also helps scientists better understand the flow of inbound matter, from which a galaxy originally forms. In the present case, the escaping ionizing radiation illuminated a long train of incoming gas, which is feeding new matter into the galaxy. The existence of such structures had been predicted by theory, but they had not been seen previously because they barely emit any light of their own.

The co-authors on this paper are George Becker and Martin Haehnelt from the Kavli Institute for Cosmology at Cambridge University, Jean-Rene Gauthier from The Kavli Institute for Cosmological Physics at the University of Chicago, Swara Ravindranath from the Inter-University Centre for Astronomy and Astrophysics, and Wallace Sargent from the Palomar Observatory at California Institute of Technology.

Story Source:

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Workers Wearing Toeshoes

By ALASTAIR MACAULAY

IN 1903, when ballet had been a prolific subject of Edgar Degas for over 30 years, an American collector, Louisine Havemeyer, asked him, "Why, monsieur, do you always do ballet dancers?" His quick reply was, "Because, madame, it is all that is left us of the combined movements of the Greeks."

This already said much: in ballet he had found a modern source of classicism. Yet Degas's body of work shows that he had found far more. His views of dance — in oil, sculpture, pastel, gouache, lithographs and other mediums — include those who aren't dancing, those who can't dance well yet, those who once danced but can do so no longer, and a great many of those who can but happen not to be doing so just now.

We need not argue about whether Degas (1834-1917) surpasses Matisse — some of Degas's late paintings may well point the way to Matisse's bold Modernist masterpiece "La Danse" — or Picasso, who designed ballets and drew dancers. But certainly no great artist has ever returned to the mechanics and sociology of the professional dancer's art more often than Degas or has understood them so well. And no artist has ever depicted ballet more truthfully — or more variously.

This fall brings the opportunity to home in on his ballet work with two different exhibitions. At the Phillips Collection in Washington "Degas's Dancers at the Barre: Point and Counterpoint" (Oct. 1 to Jan. 8) concentrates on the backstage life to which Degas had access. Centering on one late painting, "Dancers at the Barre" (around 1900), and showing his treatments of ballet as successive variations on certain themes, the exhibition emphasizes his process: the work that this painter of workers put into his art.

At the Royal Academy of Arts in London "Degas and the Ballet: Picturing Movement" (Sept. 17 to Dec. 11) focuses on his relentless scrutiny of the human body in motion, not only in his painting, prints and sculpture but in the context of the photography of the late 19th century (including some images by Degas himself) and early film technology (in which he was keenly interested).

Rewarding as both these shows will surely be, no one or two exhibitions can contain the ramifications of Degas's ballet work. There is no better way to rethink him and his views of ballet than to travel America, in whose many galleries they abound. Innumerable as his dancers seem, each adds to our sense both of Degas and of dance.

Degas made important paintings of ballet in the 1860s, but it was around 1870 when dance, especially in its classrooms, became one of his recurrent and most popular subjects. The large "Picturing Movement" show traces his progress from what the organizers call "the documentary mode of the early 1870s to the sensuous expressiveness of his later years." In old age Degas went less often to performances; he focused more on the dancers themselves. Yet his art did not shift over the years as much as refine and concentrate; he returned to old themes in new treatments. Without being less realistic or hard working, his dancers increasingly became emblems of vitality and pure form.

Keep looking at his works, early or late, and they reveal just how much his mind relished complexity. Theatergoers detest restricted views; Degas, when painting, loved them. And whereas balletomanes deplore alternative renditions of the same step, Degas relished them too.

Even in rehearsal scenes he depicted walls, constrictions, objects and people interrupting his view of dance. The foreground of "The Dance Class" (1873) — one of the works in the Phillips exhibition — features a spiral staircase (with dancers descending it) and dancers stretching. The whole painting glows — you see at once why his dance pictures soon became a large part of his international fame — and yet the thought within it is multilayered.

The two dancers in the near foreground, on the right, are neither dancing nor watching the dance. One of them is seated; Degas focuses on her fully turned-out feet, attending to the sheer physical oddity of turnout itself. Near the center of the picture two women are each poised on point. But, as always, Degas captures the different emphasis with the same pose. Though they're the ones dancing, they aren't bathed in the warm light that catches the dancers at the back of the studio, and their figures are less distinct than the legs and feet of the women who are descending the stairs on the left. If any teacher is in the room, he's out of sight.

As the painting suggests, Degas was a realist who was also subtle — guarded even — about how reality should be rendered. He once said that, were he to start an art school, it would be in six floors of a single house. Beginners would start with the model on the top floor. As students developed, they would move down, floor by floor, until they reached street level; to consult the original model, they would have to climb the stairs each time. Art for him was not just about memory, it was a Platonic conception of different layers of being.

"Life isn't a rehearsal," we often hear. Degas, by contrast, found profound meaning in a life that is almost all rehearsal. In several pictures — among those titled "The Dance Class," The Dance Lesson" or "Dancers," for instance — nobody is dancing at all. Instead, he often chose to lay ballet bare as an art form largely defined by preparation, waiting, recovery, fatigue and distraction. In "The Dance Lesson" (circa 1879), to be shown in the London exhibition, nobody is teaching, and it's not clear if anyone is learning, though two or more dancers in the mid-distance are working on classical positions by themselves. Few of his backstage dancers suggest that practice makes perfect; many of them are imperfect and not practicing.

Ballet is an art of the ideal, and yet Degas continually shows the human effort involved in achieving that ideal. He shows his dancing women not as princesses but as workers, and many of them are either contorted or weary. It is also an art of illusion, but he loved to offset its feminine dream world with the reality of the men playing in the orchestra pit, with skewed angles that expose how two-dimensional the painted scenery is, and with demonstrations that some of these delectable female visions were thoroughly disenchanted.

It's their truthfulness rather than loveliness that makes them speak directly to us. Yet even though many of his dancers aren't dancing, his eye never failed to respond to dance itself. He appreciated it as both science and art: acutely he revealed both fine details of technique and the transcendent beauties of physical harmony.

Throughout his works he kept analyzing the way in which color, form, surface, projection and distance affect the eye in dance. (In some paintings the dance is a blur beside the concrete realities of the theater or classroom around it.) He annoyed some of his Impressionist contemporaries by insisting that he was a realist (Renoir thought he was mistaken), and his art keeps asking: How many different kinds of reality are there?

His mind is at its most dazzlingly intricate in his 1870s classroom panoramas, several of which are in the Washington show. Dance, for most of those within his view, is in the past or future tense (the master who can no longer dance, the student who is learning how) or in the conditional mood (the practitioners who could if only they would). To add to the layering, mirrors in some of his classroom views (like those in the Metropolitan Museum's Degas collection) show apparently impossible reflections. Degas, it seems, is playing games.

Yet even if you focus only on his portrayals of those who are actually dancing, there's more than enough to see. For him a woman balancing on one leg is rich fare. In several paintings she is balancing on one point, and his eye alights precisely in each case on just where her waist, her arms, her shoulders, her head and her raised leg are placed. In another painting, where the dancer is on flat foot, he shows admiringly how fully turned out her supporting leg is. As with no other artist, it's as if he were inside her body, so full is his appreciation of ballet-trained musculature.

"To think that we're living in an age that has produced a sculptor to equal the ancients!" Renoir once exclaimed. Listening, the art dealer Ambroise Vollard assumed he meant Rodin. But Renoir promptly replied: "Who said anything about Rodin? Why, Degas is the greatest living sculptor!"

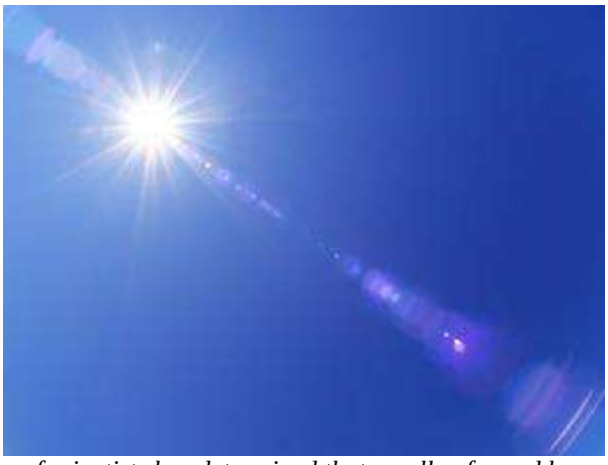
Just so: Degas's sculptures of dancers in motion — never displayed in his lifetime — are among his greatest achievements. I never tire of looking at how he fashions apparently nude dancers in arabesque. Very firmly he shapes details of a period style of dancing. The sloping downward and forward line that Degas's dancers maintain from toe to hand in arabesque penchée is a single absorbing diagonal. Nobody in ballet today holds her torso that way; some refuse to believe anyone ever did. Yet you'd better believe him. He sculptured that position with three different models (each with her own different stylistic or physical imperfections).

Though most of his dancers are anonymous, the costumes and scenery he painted have been identified in the Paris Opera repertory down to minute details, and we know the names of several of those he depicted, ranging from the old ballet teacher Jules Perrot to the student who Degas in 1881 immortalized in sculpture as "The Little 14-Year-Old Dancer," Marie van Goethem.

In all his portrayals in whatever medium, Degas returns again and again to the tension that preoccupied the ancient Greeks, and which has preoccupied ballet since the Baroque era: How can the ideal and real coexist? The immortal and the mortal? The admirable and the fallible? Sometimes Degas juxtaposes them all within the panoply of a single classroom. At other times, with mastery as much psychological as anatomical, he shows them all in the body of a single anonymous dancer.

http://www.nytimes.com/2011/09/04/arts/dance/degass-ballet-at-the-phillips-collection-and-royal-academy.html?ref=arts

Novel Alloy Could Produce Hydrogen Fuel from Sunlight



Using state-of-the-art theoretical computations, a team of scientists has determined that an alloy formed by a 2 percent substitution of antimony in gallium nitride has the right electrical properties to enable solar light energy to split water molecules into hydrogen and oxygen. (Credit: iStockphoto/Michiel De Boer)

ScienceDaily (Aug. 30, 2011) — Scientists from the University of Kentucky and the University of Louisville have determined that an inexpensive semiconductor material can be "tweaked" to generate hydrogen from water using sunlight.

The research, funded by the U.S. Department of Energy, was led by Professors Madhu Menon and R. Michael Sheetz at the University of Kentucky Center for Computational Sciences, and Professor Mahendra Sunkara and graduate student Chandrashekhar Pendyala at the University of Louisville Conn Center for Renewable Energy Research. Their findings were published Aug. 1 in the *Physical Review B.*

The researchers say their findings are a triumph for computational sciences, one that could potentially have profound implications for the future of solar energy.

Using state-of-the-art theoretical computations, the University of Kentucky-University of Louisville team demonstrated that an alloy formed by a 2 percent substitution of antimony (Sb) in gallium nitride (GaN) has the right electrical properties to enable solar light energy to split water molecules into hydrogen and oxygen, a process known as photoelectrochemical (PEC) water splitting. When the alloy is immersed in water and exposed to sunlight, the chemical bond between the hydrogen and oxygen molecules in water is broken. The hydrogen can then be collected.

"Previous research on PEC has focused on complex materials," Menon said. "We decided to go against the conventional wisdom and start with some easy-to-produce materials, even if they lacked the right arrangement of electrons to meet PEC criteria. Our goal was to see if a minimal 'tweaking' of the electronic arrangement in these materials would accomplish the desired results."

Gallium nitride is a semiconductor that has been in widespread use to make bright-light LEDs since the 1990s. Antimony is a metalloid element that has been in increased demand in recent years for applications in microelectronics. The GaN-Sb alloy is the first simple, easy-to-produce material to be considered a candidate for PEC water splitting. The alloy functions as a catalyst in the PEC reaction, meaning that it is not consumed and may be reused indefinitely. University of Louisville and University of Kentucky researchers are currently working toward producing the alloy and testing its ability to convert solar energy to hydrogen.

Hydrogen has long been touted as a likely key component in the transition to cleaner energy sources. It can be used in fuel cells to generate electricity, burned to produce heat, and utilized in internal-combustion engines to power vehicles. When combusted, hydrogen combines with oxygen to form water vapor as its only waste product. Hydrogen also has wide-ranging applications in science and industry.

Because pure hydrogen gas is not found in free abundance on Earth, it must be manufactured by unlocking it from other compounds. Thus, hydrogen is not considered an energy source, but rather an "energy carrier." Currently, it takes a large amount of electricity to generate hydrogen by water splitting. As a consequence, most of the hydrogen manufactured today is derived from non-renewable sources such as coal and natural gas.

Sunkara says the GaN-Sb alloy has the potential to convert solar energy into an economical, carbon-free source for hydrogen.

"Hydrogen production now involves a large amount of CO_2 emissions," Sunkara said. "Once this alloy material is widely available, it could conceivably be used to make zero-emissions fuel for powering homes and cars and to heat homes."

Menon says the research should attract the interest of other scientists across a variety of disciplines.

"Photocatalysis is currently one of the hottest topics in science," Menon said. "We expect the present work to have a wide appeal in the community spanning chemistry, physics and engineering."

Story Source:

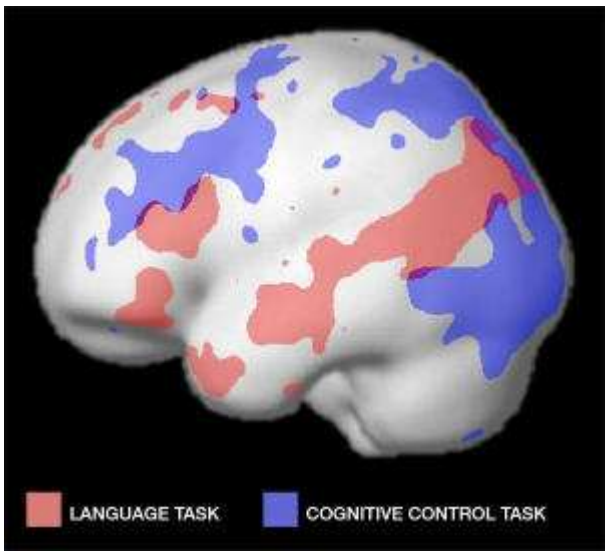
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Kentucky**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. R. Sheetz, Ernst Richter, Antonis N. Andriotis, Sergey Lisenkov, Chandrashekhar Pendyala, Mahendra K. Sunkara, Madhu Menon. **Visible-light absorption and large band-gap bowing of GaN_{1−x}Sb_{x} from first principles**. *Physical Review B*, 2011; 84 (7) DOI: 10.1103/PhysRevB.84.075304

http://www.sciencedaily.com/releases/2011/08/110830151229.htm

Localizing Language in the Brain: Study Pinpoints Areas of the Brain Used Exclusively for Language



A map of the different brain areas that are active while a subject performs a language task (red) and a cognitive control task (blue), showing that nearby but distinct regions are used for each activity. (Credit: Image courtesy of Fedorenko et al.)

ScienceDaily (Aug. 30, 2011) — New research from MIT suggests that there are parts of our brain dedicated to language and only language, a finding that marks a major advance in the search for brain regions specialized for sophisticated mental functions.

Functional specificity, as it's known to cognitive scientists, refers to the idea that discrete parts of the brain handle distinct tasks. Scientists have long known that functional specificity exists in certain domains: In the motor system, for example, there is one patch of neurons that controls the fingers of your left hand, and another that controls your tongue. But what about more complex functions such as recognizing faces, using language or doing math? Are there special brain regions for those activities, or do they use general-purpose areas that serve whatever task is at hand?

Language, a cognitive skill that is both unique to humans and universal to all human cultures, "seems like one of the first places one would look" for this kind of specificity, says Evelina Fedorenko, a research scientist in MIT's Department of Brain and Cognitive Sciences and first author of the new study. But data from neuroimaging -- especially functional magnetic resonance imaging (fMRI), which measures brain activity associated with cognitive tasks -- has been frustratingly inconclusive. Though studies have largely converged on several areas important for language, it's been hard to say whether those areas are exclusive to language. Many experiments have found that non-language tasks seemingly activate the same areas: Arithmetic, working memory and music are some of the most common culprits.

But according to Fedorenko and her co-authors -- Nancy Kanwisher, the Walter A. Rosenblith Professor of Cognitive Neuroscience, and undergraduate student Michael Behr -- this apparent overlap may simply be due to flaws in methodology, i.e., how fMRI data is traditionally gathered and analyzed. In their new study, published in this week's *Proceedings of the National Academy of Sciences*, they used an innovative technique they've been developing over the past few years; the new method yielded evidence that there are, in fact, bits of the brain that do language and nothing else.

Forget the forest, it's all in the trees

fMRI studies of language are typically done by group analysis, meaning that researchers test 10, 20 or even 50 subjects, then average data together onto a common brain space to search for regions that are active across brains.

But Fedorenko says this is not an ideal way to do things, mainly because the fine-grained anatomical differences between brains can cause data "smearing," making it look as if one region is active in two different tasks when in reality, the tasks activate two neighboring -- but not overlapping -- regions in each individual subject.

By way of analogy, she says, imagine taking pictures of 10 people's faces and overlaying them, one on top of another, to achieve some sort of average face. While the resulting image would certainly look like a face, when you compared it back to the original pictures, it would not line up perfectly with any of them. That's because there is natural variation in our features -- the size of our foreheads, the width of our noses, the distance between our eyes.

It's the same way for brains. "Brains are different in their folding patterns, and where exactly the different functional areas fall relative to these patterns," Fedorenko says. "The general layout is similar, but there isn't fine-grained matching." So, she says, analyzing data by "aligning brains in some common space … is just never going to be quite right."

Ideally, then, data would be analyzed for each subject individually; that is, patterns of activity in one brain would only ever be compared to patterns of activity from that same brain. To do this, the researchers spend the first 10 to 15 minutes of each fMRI scan having their subject do a fairly sophisticated language task while tracking brain activity. This way, they establish where the language areas lie in that individual subject, so that later, when the subject performs other cognitive tasks, they can compare those activation patterns to the ones elicited by language.

A linguistic game of 'Where's Waldo?'

This methodology is exactly what allows Fedorenko, Behr and Kanwisher to see if there are areas truly specific to language. After having their subjects perform the initial language task, which they call a "functional localizer," they had each one do a subset of seven other experiments: one on exact arithmetic, two on working memory, three on cognitive control and one on music, since these are the functions "most commonly argued to share neural machinery with language," Fedorenko says.

Out of the nine regions they analyzed -- four in the left frontal lobe, including the region known as Broca's area, and five further back in the left hemisphere -- eight uniquely supported language, showing no significant activation for any of the seven other tasks. These findings indicate a "striking degree of functional specificity for language," as the researchers report in their paper.

Future studies will test the newly identified language areas with even more non-language tasks to see if their functional specificity holds up; the researchers also plan to delve deeper into these areas to discover which particular linguistic jobs each is responsible for.

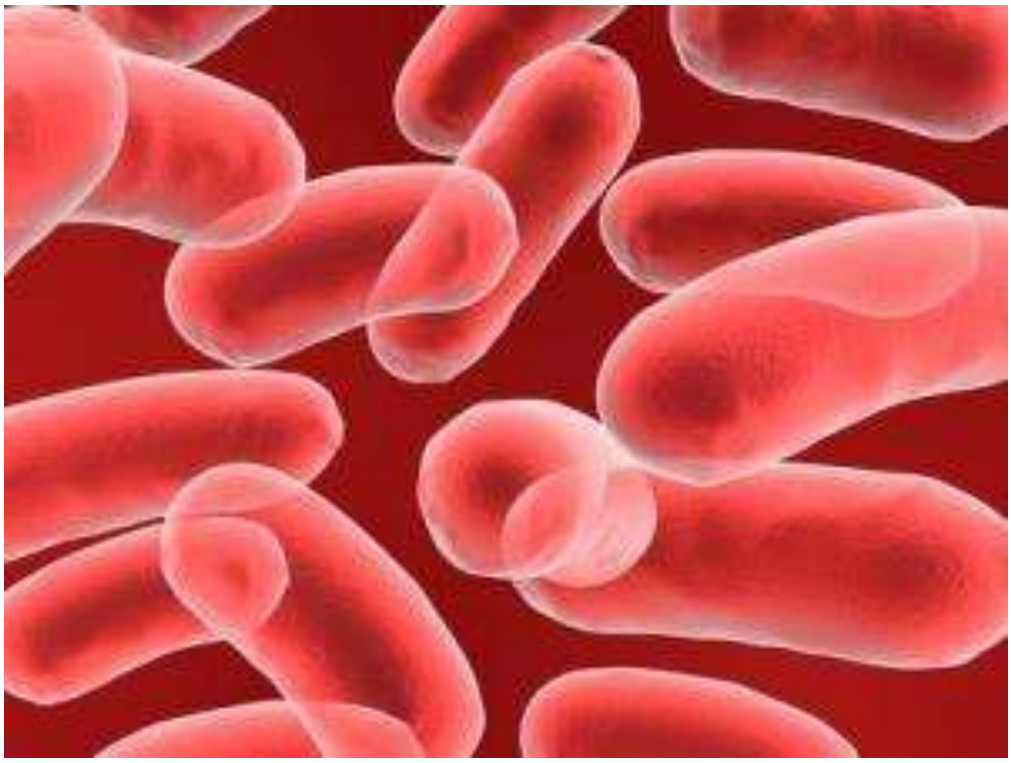
Fedorenko says the results don't imply that every cognitive function has its own dedicated piece of cortex; after all, we're able to learn new skills, so there must be some parts of the brain that are both high-level and functionally flexible. Still, she says, the results give hope to researchers looking to draw some distinctions within in the human cortex: "Brain regions that do related things may be nearby … [but] it's not just all one big mushy multifunctional thing in there."

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 Emily Finn.

http://www.sciencedaily.com/releases/2011/08/110830102554.htm

New Method Reveals Parts of Bacterial Genome Essential to Life



A research team has cataloged exactly what parts of the genetic code are essential for survival in a bacterial species. (Credit: © Yang MingQi / Fotolia)

ScienceDaily (Aug. 30, 2011) — A team at the Stanford University School of Medicine has cataloged, down to the letter, exactly what parts of the genetic code are essential for survival in one bacterial species, *Caulobacter crescentus.*

They found that 12 percent of the bacteria's genetic material is essential for survival under laboratory conditions. The essential elements included not only protein-coding genes, but also regulatory DNA and, intriguingly, other small DNA segments of unknown function. The other 88 percent of the genome could be disrupted without harming the bacteria's ability to grow and reproduce.

The study, which was enabled by the team's development of an extremely efficient new method of genetic analysis, paves the way for better understanding of how bacterial life evolved and for improving identification of DNA elements that are essential for many bacterial processes, including the survival of pathogenic bacteria in an infected person. It will be published online Aug. 30 in *Molecular Systems Biology*.

"This work addresses a fundamental question in biology: What is essential for life?" said Beat Christen, PhD, one of the co-first authors of the new paper and a postdoctoral scholar in developmental biology. "We came up with a method to identify all the parts of the genome required for life."

The bacteria studied is a non-pathogenic freshwater species that has long been used in molecular biology research. Its complete genome was sequenced in 2001, but knowing the letters in its genetic code did not tell the researchers which bits of DNA were important to the bacteria.

"There were many surprises in the analysis of the essential regions of Caulobacter's genome," said Lucy Shapiro, PhD, the paper's senior author. "For instance, we found 91 essential DNA segments where we have no idea what they do. These may provide clues to lead us to new and completely unknown bacterial functions." Shapiro is a professor of developmental biology and the director of the Beckman Center for Molecular and Genetic Medicine at Stanford.

Caulobacter's DNA, like that of most bacteria, is a single, ring-shaped chromosome. To perform their experiment, the researchers mutated many Caulobacter cells so that each cell incorporated one piece of artificial DNA at a random location in its chromosome. The artificial DNA, which was labeled so the scientists could find it later, disrupted the function of the region of bacterial DNA where it landed. Over two days, the researchers grew these mutants until they had about 1 million bacterial cells, and then sequenced their DNA. After intensive computer analysis, they created a detailed map of the entire bacterial genome to show exactly where the artificial DNA segments had been inserted in the chromosome of the surviving cells.

This mutation map contained many gaps -- the regions of the DNA where no living bacteria had survived with an artificial DNA insertion. These regions, the researchers reasoned, must be essential for bacterial life since disrupting them prevented bacterial survival.

"We were looking for the dog that didn't bark," Shapiro said.

Scientists have used a similar mapping strategy to find essential genetic elements before, but the Stanford team added several innovations that greatly improved the speed and resolution of the method.

"Our method is very streamlined," Christen said. "We can do an analysis that would have taken years in a few weeks. We can immediately go to the answer."

The new method collapses into a single experiment work that used to take dozens of experimental steps, and shifts the majority of the time needed for the research from laboratory work to data analysis.

In total, the essential Caulobacter genome was 492,941 base pairs long and included 480 protein-coding genes that were clustered in two regions of the chromosome. The researchers also identified 402 essential promoter regions that increase or decrease the activity of those genes, and 130 segments of DNA that do not code for proteins but have other roles in modifying bacterial metabolism or reproduction. Of the individual DNA regions identified as essential, 91 were non-coding regions of unknown function and 49 were genes coding proteins whose function is unknown. Learning the functions of these mysterious regions will expand our knowledge of bacterial metabolism, the team said.

The research team anticipates that the new technique will have several interesting uses in both basic and applied research. For instance, the technique provides a rapid and economical method to learn which genetic elements are essential in any microbial species.

"This would give fundamental information so we could determine which essential genetic elements are conserved through evolution," said co-author Harley McAdams, PhD, professor of developmental biology.

The scientists also pointed out that the method could be used to examine which DNA segments are essential for bacterial survival in specific circumstances, such as when pathogenic bacteria invade a host animal or plant. Developing a comprehensive list of genetic elements that make a bacterial species infectious could lead to the identification of new anti-infective agents including new antibiotics.

The research team included co-first author Eduardo Abeliuk, an electrical engineering graduate student; research associate John Collier, PhD; senior research scientist Virginia Kalogeraki, PhD; Ben Passarelli,

director of computing at the Stanford Functional Genomics Facility; John Coller, PhD, director of the Stanford Functional Genomics Facility; and Michael Fero, PhD, a National Institute of General Medical Sciences Quantitative Research Fellow at Stanford.

The research was funded by grants from the Department of Energy's Office of Science, the National Institutes of Health, the Swiss National Foundation and a LaRoche Foundation Fellowship.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Stanford University Medical Center**. The original article was written by Erin Digitale.

Journal Reference:

1. Beat Christen, Eduardo Abeliuk, John M Collier, Virginia S Kalogeraki, Ben Passarelli, John A Coller, Michael J Fero, Harley H McAdams and Lucy Shapiro. **The essential genome of a bacterium**. *Molecular Systems Biology*, 2011; DOI: 10.1038/msb.2011.58

http://www.sciencedaily.com/releases/2011/08/110830092356.htm

Preserving 4 Percent of the Ocean Could Protect Most Marine Mammal Species, Study Finds

Setting aside nine critical ocean conservation sites would protect habitat for the vast majority of marine mammal species on Earth, including humpback whales. (Credit: NOAA)

ScienceDaily (Aug. 30, 2011) — Preserving just 4 percent of the ocean could protect crucial habitat for the vast majority of marine mammal species, from sea otters to blue whales, according to researchers at Stanford University and the National Autonomous University of Mexico.

Their findings were published in the Aug. 16 edition of the *Proceedings of the National Academy of Sciences*.

Of the 129 species of marine mammals on Earth, including seals, dolphins and polar bears, approximately one-quarter are facing extinction, the study said.

"It's important to protect marine mammals if you want to keep the ocean's ecosystems functional," said study co-author Paul Ehrlich, professor of biology and senior fellow at the Woods Institute for the Environment at Stanford. "Many of them are top predators and have impacts all the way through the ecosystem. And they're also beautiful and interesting."

Mapping marine mammals

To pinpoint areas of the ocean where conservation could protect the maximum number of species and the ones most vulnerable to extinction, the researchers overlaid maps of where each marine mammal species is found. Their composite map revealed locations with the highest "species richness" -- the highest number of different species.

"This is the first time that the global distribution of marine mammal richness has been compiled and presented as a map," said co-authors Sandra Pompa and Gerardo Ceballos of the National Autonomous University of

Mexico. "The most surprising and interesting result was that all of the species can be represented in only 20 critical conservation locations that cover at least 10 percent of the species' geographic range."

The researchers identified the 20 conservation sites based on three main criteria: how many species were present, how severe the risk of extinction was for each species and whether any of the species were unique to the area. The scientists also considered habitats of special importance to marine mammals, such as breeding grounds and migration routes.

Nine key sites

It turned out that preserving just nine of the 20 conservation sites would protect habitat for 84 percent of all marine mammal species on Earth, the scientists found. That's because those nine locations have very high species richness, providing habitat for 108 marine mammal species in all.

These nine sites, which make up only 4 percent of the world's ocean, are located off the coasts of Baja California in Mexico, eastern Canada, Peru, Argentina, northwestern Africa, South Africa, Japan, Australia and New Zealand, the study reported.

The researchers also looked at how pollution, local climate disruption and commercial shipping overlapped with species richness in or near the nine key sites. "At least 70 percent of the richness areas coincide with regions highly impacted by humans," said Pompa and Ceballos. "This is powerful information that obliges us to enhance marine conservation."

Factoring in other impacts, such as overfishing and global climate change, would likely reveal even more negative effects on the nine conservation sites, the authors said.

"The next 2 billion people we're going to add to the planet are going to do much more damage to the ocean than the previous 2 billion did," said Ehrlich, president of the Stanford Center for Conservation Biology. "Humans reach for the low-hanging fruit first, so to speak, but for the ocean that's gone now."

Unique creatures

While nine of the conservation sites harbor numerous marine mammal species, the remaining 11 sites boast species found nowhere else. Preserving these areas is important, because species that live exclusively in one place may be at especially high risk for extinction, the authors said. For example, the critically endangered vaquita, or gulf porpoise, lives only in the upper northern Gulf of California, and only a few hundred individuals remain, the researchers noted.

"We need to conserve what's left of the biota of the planet, both on land and in the sea," said Ehrlich. "We need to know where the biodiversity is before we can take many of the necessary steps to conserve it. This is just a start on the mammals of the sea."

The study was supported by grants from the National Autonomous University of Mexico, EcoCiencia Sociedad Civil, Mexico's National Council for Science and Technology and the Cetacean Society International.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Stanford University**. The original article was written by Sascha Zubryd, science-writing intern at the Woods Institute for the Environment at Stanford University.

Journal Reference:

1. S. Pompa, P. R. Ehrlich, G. Ceballos. **Global distribution and conservation of marine mammals**. *Proceedings of the National Academy of Sciences*, 2011; 108 (33): 13600 DOI: 10.1073/pnas.1101525108

http://www.sciencedaily.com/releases/2011/08/110829115431.htm

Mind-Altering Microbes: Probiotic Bacteria May Lessen Anxiety and Depression

Professor John Cryan, Alimentary Pharmabiotic Centre, University College Cork (Credit: Image courtesy of University College Cork)

ScienceDaily (Aug. 30, 2011) — Probiotic bacteria have the potential to alter brain neurochemistry and treat anxiety and depression-related disorders according to research published in the *Proceedings of the National Academy of Sciences.*

The research, carried out by Dr Javier Bravo, and Professor John Cryan at the Alimentary Pharmabiotic Centre in University College Cork, along with collaborators from the Brain-Body Institute at McMaster University in Canada, demonstrated that mice fed with *Lactobacillus rhamnosus* JB-1 showed significantly fewer stress, anxiety and depression-related behaviours than those fed with just broth. Moreover, ingestion of the bacteria resulted in significantly lower levels of the stress-induced hormone, corticosterone.

"This study identifies potential brain targets and a pathway through which certain gut organisms can alter mouse brain chemistry and behaviour. These findings highlight the important role that gut bacteria play in the bidirectional communication between the gut and the brain, the gut-brain axis, and opens up the intriguing opportunity of developing unique microbial-based strategies for treatment for stress-related psychiatric disorders such as anxiety and depression," said John F. Cryan, senior author on the publication and Professor of Anatomy and Principal Investigator at the Science Foundation Ireland funded Alimentary Pharmabiotic Centre, at UCC. The APC researchers included Dr Hélène Savignac and Professor Ted Dinan.

The researchers also showed that regular feeding with the Lactobacillus strain caused changes in the expression of receptors for the neurotransmitter GABA in the mouse brain, which is the first time that it has

been demonstrated that potential probiotics have a direct effect on brain chemistry in normal situations. The authors also established that the vagus nerve is the main relay between the microbiome (bacteria in the gut) and the brain. This three way communication system is known as the microbiome-gut-brain axis and these findings highlight the important role of bacteria in the communication between the gut and the brain, and suggest that certain probiotic organisms may prove to be useful adjunct therapies in stress-related psychiatric disorders.

Story Source:

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

Journal Reference:

1. Javier A. Bravo, Paul Forsythe, Marianne V. Chew, Emily Escaravage, Hélène M. Savignac, Timothy G. Dinan, John Bienenstock, John F. Cryan. **Ingestion of Lactobacillus strain regulates emotional behavior and central GABA receptor expression in a mouse via the vagus nerve**. *Proceedings of the National Academy of Sciences*, 2011; DOI: 10.1073/pnas.1102999108

http://www.sciencedaily.com/releases/2011/08/110829164601.htm

Bilingual Babies' Vocabulary Linked to Early Brain Differentiation

This is one of the babies in the experiment wearing an EEG cap that measures brain activity. (Credit: University of Texas at San Antonio)

ScienceDaily (Aug. 29, 2011) — Babies and children are whizzes at learning a second language, but that ability begins to fade as early as their first birthdays.

Researchers at the University of Washington's Institute for Learning & Brain Sciences are investigating the brain mechanisms that contribute to infants' prowess at learning languages, with the hope that the findings could boost bilingualism in adults, too.

In a new study, the researchers report that the brains of babies raised in bilingual households show a longer period of being flexible to different languages, especially if they hear a lot of language at home. The researchers also show that the relative amount of each language -- English and Spanish -- babies were exposed to affected their vocabulary as toddlers.

The study, published online Aug. 17 in *Journal of Phonetics*, is the first to measure brain activity throughout infancy and relate it to language exposure and speaking ability.

"The bilingual brain is fascinating because it reflects humans' abilities for flexible thinking -- bilingual babies learn that objects and events in the world have two names, and flexibly switch between these labels, giving the brain lots of good exercise," said Patricia Kuhl, co-author of the study and co-director of the UW's Institute for Learning & Brain Sciences.

Kuhl's previous studies show that between 8 and 10 months of age, monolingual babies become increasingly able to distinguish speech sounds of their native language, while at the same time their ability to distinguish sounds from a foreign language declines. For instance, between 8 and 10 months of age babies exposed to English become better at detecting the difference between "r" and "l" sounds, which are prevalent in the English language. This is the same age when Japanese babies, who are not exposed to as many "r" and "l" sounds, decline in their ability to detect them.

"The infant brain tunes itself to the sounds of the language during this sensitive period in development, and we're trying to figure out exactly how that happens," said Kuhl, who's also a UW professor of speech and hearing sciences. "But almost nothing is known about how bilingual babies do this for two languages. Knowing how experience sculpts the brain will tell us something that goes way beyond language development."

In the current study, babies from monolingual (English or Spanish) and bilingual (English and Spanish) households wore caps fitted with electrodes to measure brain activity with an electroencephalogram, or EEG, a device that records the flow of energy in the brain. Babies heard background speech sounds in one language, and then a contrasting sound in the other language occurred occasionally.

For example, a sound that is used in both Spanish and English served as the background sound and then a Spanish "da" and an English "ta" each randomly occurred 10 percent of the time as contrasting sounds. If the brain can detect the contrasting sound, there is a signature pattern called the mismatch response that can be detected with the EEG.

Monolingual babies at 6-9 months of age showed the mismatch response for both the Spanish and English contrasting sounds, indicating that they noticed the change in both languages. But at 10-12 months of age, monolingual babies only responded to the English contrasting sound.

Bilingual babies showed a different pattern. At 6-9 months, bilinguals did not show the mismatch response, but at 10-12 months they showed the mismatch for both sounds.

This suggests that the bilingual brain remains flexible to languages for a longer period of time, possibly because bilingual infants are exposed to a greater variety of speech sounds at home.

This difference in development suggests that the bilingual babies "may have a different timetable for neurally committing to a language" compared with monolingual babies, said Adrian Garcia-Sierra, lead author and a postdoctoral researcher at UW's Institute for Learning & Brain Sciences.

"When the brain is exposed to two languages rather than only one, the most adaptive response is to stay open longer before showing the perceptual narrowing that monolingual infants typically show at the end of the first year of life," Garcia-Sierra said.

To see if those brain responses at 10-12 months related to later speaking skills, the researchers followed up with the parents when the babies were about 15 months old to see how many Spanish and English words the children knew. They found that early brain responses to language could predict infants' word learning ability. That is, the size of the bilingual children's vocabulary was associated with the strength of their brain responses in discriminating languages at 10-12 months of age.

Early exposure to language also made a difference: Bilingual babies exposed to more English at home, including from their parents, other relatives and family friends, subsequently produced more words in English. The pattern held true for Spanish.

The researchers say the best way for children to learn a second language is through social interactions and daily exposure to the language.

"Learning a second language is like learning a sport," said Garcia-Sierra, who is raising his two young children as bilingual. "The more you play the better you get."

Co-authors are Maritza Rivera-Gaxiola, formerly a UW research scientist; Cherie Percaccio, a postdoctoral researcher and Lindsay Klarman, a research technician at the UW Institute for Learning & Brain Sciences; Barbara Conboy, a speech-language pathologist at the University of Redlands; and Harriett Romo, director, and Sophia Ortiz, assistant director, of the Child & Adolescent Policy Research Center at the University of Texas at San Antonio.

The National Science Foundation Science of Learning Program grant to the UW's LIFE Center, a multi-institutional program, funded the study.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Washington**. The original article was written by Molly McElroy.

Journal Reference:

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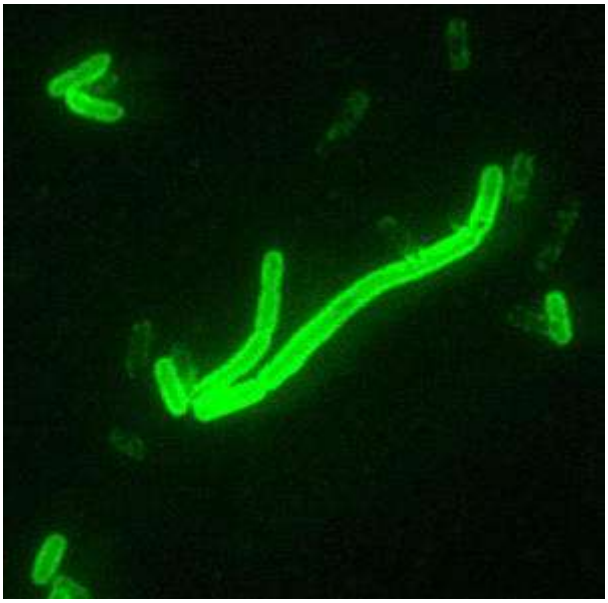
http://www.sciencedaily.com/releases/2011/08/110829070559.htm

Black Death Bacterium Identified: Genetic Analysis of Medieval Plague Skeletons Shows Presence of Yersinia Pestis Bacteria



Yersinia pestis, direct fluorescent antibody stain (DFA), 200x magnification. (Credit: CDC/Courtesy of Larry Stauffer, Oregon State Public Health Laboratory)

ScienceDaily (Aug. 29, 2011) — A team of German and Canadian scientists has shown that today's plague pathogen has been around at least 600 years.

The Black Death claimed the lives of one-third of Europeans in just five years from 1348 to 1353. Until recently, it was not certain whether the bacterium *Yersinia pestis* -- known to cause the plague today -- was responsible for that most deadly outbreak of disease ever. Now, the University of Tübingen's Institute of Scientific Archaeology and McMaster University in Canada have been able to confirm that *Yersinia pestis* was behind the great plague.

The results of the research are published in the *Proceedings of the National Academy of Sciences*.

Previous genetic tests indicating that the bacterium was present in medieval samples had previously been dismissed as contaminated by modern DNA or the DNA of bacteria in the soil. Above all, there was doubt because the modern plague pathogen spreads much more slowly and is less deadly than the medieval plague -- even allowing for modern medicine.

The international team of researchers has for the first time been able to decode a circular genome important for explaining the virulence of *Y. pestis.* It is called pPCP1 plasmid and comprises about 10,000 positions in the bacterium's DNA. The sample was taken from skeletons from a London plague cemetery. The working group in Tübingen, led by Dr. Johannes Krause used a new technique of "molecular fishing" -- enriching plague DNA fragments from tooth enamel and sequencing them using the latest technology. In this way, the fragments were connected up into a long genome sequence -- which turned out to be identical to modern-day plague pathogens. "That indicates that at least this part of the genetic information has barely changed in the past 600 years," says Krause.

The researchers were also able to show that the plague DNA from the London cemetery was indeed medieval. To do that, they examined damage to the DNA which only occurs in old DNA -- therefore excluding the

possibility of modern contamination. "Without a doubt, the plague pathogen known today as *Y. pestis* was also the cause of the plague in the Middle Ages," says Krause, who is well known for his DNA sequencing of ancient hominin finds, which help trace relationships between types of prehistoric man and modern humans.

Story Source:

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

Journal Reference:

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http://www.sciencedaily.com/releases/2011/08/110829173751.htm

Astrophysicists Solve 40-Year-Old Mariner 5 Solar Wind Problem: Turbulence Doesn't Go With the Flow

Artist's impression of Cluster mission. (Credit: European Space Agency)

ScienceDaily (Aug. 29, 2011) — Research led by astrophysicists at the University of Warwick has resolved a 40-year-old problem with observations of turbulence in the solar wind first made by the probe Mariner 5. The research resolves an issue with what is by far the largest and most interesting natural turbulence lab accessible to researchers today.

Our current understanding tells us that turbulence in the solar wind should not be affected by the speed and direction of travel of that solar wind. However when the first space probes attempted to measure that turbulence they found their observations didn't quite match that physical law. The first such data to be analysed from Mariner 5 in 1971 found a small but nonetheless irritatingly clear pattern in the turbulence perpendicular to both the direction of the travel and the magnetic field the solar wind was travelling through.

While it was an irritating aberration the affect was relatively small and has been essentially ignored by physicists until now. However the most recent space missions to look at the solar wind, such as the Cluster mission, are examining it with such sensitive and highly accurate modern instrumentation that what was once a small aberration was threatening to become a significant stumbling block to us getting a deeper understanding of what is going on in the solar wind -- which is effectively the solar system's largest and most interesting natural turbulence lab.

Research led by Andrew Turner and Professor Sandra Chapman in Centre for Fusion, Space and Astrophysics at the University of Warwick has found a solution to this 40 year old problem. The research team looked at data from the Cluster mission and they also created a virtual model of how magnetohydrodynamic (MHD) turbulence builds up in the Solar wind. They then flew a virtual space probe through that virtual model in a range of directions unlike the single direction of travel open to a probe such as Mariner 5.

University of Warwick researcher Andrew Turner said that what they found was that: "The analysis clearly showed that when all these results were considered together any correlation between changes in the turbulence in the solar wind and the direction of travel simply disappeared. The observed non-axisymmetric anisotropy may simply arise as a sampling effect of using just one probe taking a single particular path through the solar wind."

The research paper is published in *Physical Review Letters* and is by A.J. Turner, S. Chapman, B. Hnat, Centre for Fusion, Space and Astrophysics, University of Warwick; G. Gogoberidze, Centre for Fusion, Space

and Astrophysics, University of Warwick and the Institute of Theoretical Physics, Ilia State University; and W.C.Müller of the Max-Planck-Institut für Plasmaphysik.

Story Source:

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

Journal Reference:

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http://www.sciencedaily.com/releases/2011/08/110826085147.htm

Sutureless Method for Joining Blood Vessels Invented

A team headed by Geoffrey Gurtner has developed a way of joining severed blood vessels without stitching them together with sutures. (Credit: Steve Fisch)

ScienceDaily (Aug. 29, 2011) — Reconnecting severed blood vessels is mostly done the same way today -- with sutures -- as it was 100 years ago, when the French surgeon Alexis Carrel won a Nobel Prize for advancing the technique. Now, a team of researchers at the Stanford University School of Medicine has developed a sutureless method that appears to be a faster, safer and easier alternative.

In animal studies, a team led by Stanford microsurgeon Geoffrey Gurtner, MD, used a poloxamer gel and bioadhesive rather than a needle and thread to join together blood vessels, a procedure called vascular anastomosis. Results of the research are published online Aug. 28 in *Nature Medicine*. Lead authors of the study were Stanford postdoctoral scholar Edward Chang, MD, and surgery resident Michael Galvez, MD.

The big drawback of sutures is that they are difficult to use on blood vessels less than 1 millimeter wide. Gurtner began thinking about alternatives to sutures about a decade ago. "Back in 2002, I was chief of microsurgery at Bellevue in New York City, and we had an infant -- 10 to 12 months old -- who had a finger amputated by the spinning wheel of an indoor exercise bike," said Gurtner, senior author of the study and professor of surgery. "We struggled with reattaching the digit because the blood vessels were so small -- maybe half a millimeter. The surgery took more than five hours, and at the end we were only able to get in three sutures.

"Everything turned out OK in that case," he continued. "But what struck me was how the whole paradigm of sewing with a needle and thread kind of falls apart at that level of smallness."

Sutures are troublesome in other ways, too. They can lead to complications, such as intimal hyperplasia, in which cells respond to the trauma of the needle and thread by proliferating on the inside wall of the blood vessel, causing it to narrow at that point. This increases the risk of a blood clot getting stuck and obstructing blood flow. In addition, sutures may trigger an immune response, leading to inflamed tissue that also increases the risk of a blockage.

The new method could sidestep these problems. "Ultimately, this has the potential to improve patient care by decreasing amputations, strokes and heart attacks while reducing health-care costs," the authors write in the study.

Earlier in his career, as Gurtner contemplated a better way of joining together blood vessels, he considered whether ice could be used to fill the lumen, the inner space of the blood vessel, to keep both ends open to their full diameter long enough to glue them together. Not feasible, he concluded. "Water turns to ice quite slowly

and you would have to drop the temperature of the surgical site a lot -- from 98.6 degrees to 32 degrees Fahrenheit," he said.

Shortly after arriving at Stanford in 2005, Gurtner approached fellow faculty member Gerald Fuller, PhD, professor of chemical engineering and the Fletcher Jones II Professor in the School of Engineering, about whether he knew of a substance that could be turned easily from a liquid to a solid and back to a liquid again, and that would also be safe to use in vascular surgery. Fuller immediately suggested a Food and Drug Administration-approved thermoreversible poloxamer called Poloxamer 407. It is constructed of polymer blocks whose properties can be reversed by heating.

Fuller teamed up with Jayakumar Rajadas, PhD, director of the Stanford Biomaterials and Advanced Drug Delivery Laboratory, to modify the poloxamer so that it would become solid and elastic when heated above body temperature but dissolve harmlessly into the bloodstream when cooled. The poloxamer then was used to distend both openings of a severed blood vessel, allowing researchers to glue them together precisely.

The researchers used a simple halogen lamp to heat the gel. In tests on animals, the technique was found to be five times faster than the traditional hand-sewn method, according to the study. It also resulted in considerably less inflammation and scarring after two years. The method even worked on extremely slim blood vessels -- those only 0.2 mm wide -- which would have been too tiny and delicate for sutures. "That's where it really shines," Gurtner said.

Dermabond, a surgical sealant, was used to attach the ends of the blood vessels together.

Poloxamers have been used before as a vehicle for delivering drugs, including chemotherapeutics, vaccines and anti-viral therapies. Researchers have used Poloxamer 407 to occlude blood vessels in experimental animals for the purpose of evaluating the gel's safety and efficacy in so-called "beating heart surgery," in which certain vessels need to be temporarily blocked to improve visibility for the surgeons performing a coronary artery bypass.

Although other sutureless methods have been developed, they generally have not produced better outcomes, the authors said. "Often, the use of microclips, staples or magnets is itself traumatic to blood vessels leading to failure rates comparable to or higher than sutured anastomoses," they wrote.

"This is a novel approach to anastomosis that could play a valuable role in microvascular surgery," said Frank Sellke, MD, chief of cardiothoracic surgery at Brown University Medical Center and associate editor of the *Journal of Thoracic and Cardiovascular Surgery*, who was not involved in the study. "But it really needs to show that it holds up in clinical trials."

The authors say further testing on large animals is needed before human trials can begin, but they note that all of the components used in the technique are already approved by the FDA. "This technology has the potential to progress rapidly from the 'bench to bedside,'" they write.

Gurtner said he believes the new technique could satisfy a huge unmet need and prove especially useful in minimally invasive surgeries, in which manipulating sutures takes on a whole new level of difficulty.

Michael Longaker, MD, the Deane P. and Louise Mitchell Professor in the School of Medicine and a co-author of the study, called the technique a "potential game-changer."

"When you're bringing together hollow tubes, whether they're large structures, like the colon or the aorta, or a small structure, like a vein in the finger of a child, you're always worried about lining them up directly and

effectively sealing them," Longaker said. "The technique that Dr. Gurtner has pioneered could allow surgeons to perform anastomosis more quickly and with improved precision."

He continued: "Coming up with this solution was the result of the classic Stanford model of bringing together researchers from a variety of disciplines."

Other Stanford co-authors of the study were postdoctoral scholars Jason Glotzbach, MD, Kristin-Maria Sommer, PhD, Oscar Abilez, MD, PhD, and Cynthia Hamou, MD; medical student Samyra El-ftesi; and technician Travis Rappleye.

The work was supported by a Stanford Bio-X Interdisciplinary Initiatives Research Award and the Oak Foundation. Stanford University has patented the technology.

Gurtner and Longaker are also members of the Stanford Cancer Institute.

Story Source:

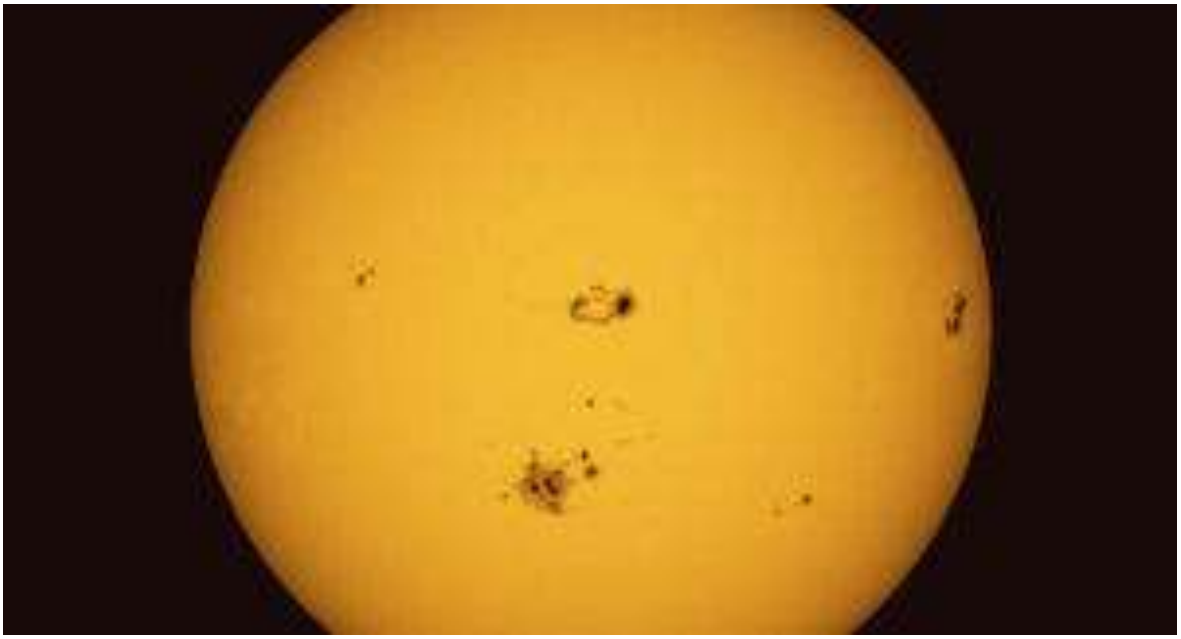
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Stanford University Medical Center**. The original article was written by John Sanford.

Journal Reference:

1. Edward I Chang, Michael G Galvez, Jason P Glotzbach, Cynthia D Hamou, Samyra El-ftesi, C Travis Rappleye, Kristin-Maria Sommer, Jayakumar Rajadas, Oscar J Abilez, Gerald G Fuller, Michael T Longaker, Geoffrey C Gurtner. **Vascular anastomosis using controlled phase transitions in poloxamer gels**. *Nature Medicine*, 2011; DOI: 10.1038/nm.2424

http://www.sciencedaily.com/releases/2011/08/110828141052.htm

New Method Detects Emerging Sunspots Deep Inside the Sun, Provides Warning of Dangerous Solar Flares



Stanford researchers have found a way to detect sunspots such as these two days before they reach the surface of the sun. (Credit: Thomas Hartlep)

ScienceDaily (Aug. 29, 2011) — Viewed from the technological perspective of modern humans, the sun is a seething cauldron of disruptive influences that can wreak havoc on communication systems, air travel, power grids and satellites -- not to mention astronauts in space.

If disruptions such as solar flares and mass eruptions could be predicted, protective measures could be taken to shield vulnerable electronics before solar storms strike.

Now Stanford researchers have developed a method that allows them to peer deep into the sun's interior, using acoustic waves to catch sunspots in the early stage of development and giving as much as two days' warning.

Sunspots develop in active solar regions of strong, concentrated magnetic fields and appear dark when they reach the surface of the sun. Eruptions of the intense magnetic flux give rise to solar storms, but until now, no one has had luck in predicting them.

"Many solar physicists tried different ways to predict when sunspots would appear, but with no success," said Phil Scherrer, a professor of physics in whose lab the research was conducted.

The key to the new method is using acoustic waves generated inside the sun by the turbulent motion of plasma and gases in constant motion. In the near-surface region, small-scale convection cells -- about the size of California -- generate sound waves that travel to the interior of the sun and are refracted back to the surface.

The researchers got help from the Michelson Doppler Imager aboard NASA's Solar and Heliospheric Observatory satellite, known as SOHO. The craft spent 15 years making detailed observations of the sound

waves within the sun. It was superseded in 2010 with the launch of NASA's Solar Dynamics Observatory satellite, which carries the Helioseismic and Magnetic Imager.

Using the masses of data generated by the two imagers, Stathis Ilonidis, a Stanford graduate student in physics, was able to develop a way to reduce the electronic clutter in the data so he could accurately measure the solar sounds.

The new method enabled Ilonidis to detect sunspots in the early stages of formation as deep as 65,000 kilometers inside the sun. Between one and two days later, the sunspots would appear on the surface. Ilonidis is the lead author of a paper describing the research, published in the Aug. 19 edition of *Science.*

The principles used to track and measure the acoustic waves traveling through the sun are comparable to measuring seismic waves on Earth. The researchers measure the travel time of acoustic waves between widely separated points on the solar surface.

"We know enough about the structure of the sun that we can predict the travel path and travel time of an acoustic wave as it propagates through the interior of the sun," said Junwei Zhao, a senior research scientist at Stanford's Hansen Experimental Physics Lab. "Travel times get perturbed if there are magnetic fields located along the wave's travel path." Those perturbations are what tip the researchers that a sunspot is forming.

By measuring and comparing millions of pairs of points and the travel times between them, the researchers are able to home in on the anomalies that reveal the growing presence of magnetic flux associated with an incipient sunspot.

They found that sunspots that ultimately become large rise up to the surface more quickly than ones that stay small. The larger sunspots are the ones that spawn the biggest disruptions, and for those the warning time is roughly a day. The smaller ones can be found up to two days before they reach the surface.

"Researchers have suspected for a long time that sunspot regions are generated in the deep solar interior, but until now the emergence of these regions through the convection zone to the surface had gone undetected," Ilonidis said. "We have now successfully detected them four times and tracked them moving upward at speeds between 1,000 and 2,000 kilometers per hour."

One of the big goals with forecasting space weather is achieving a three-day warning time of impending solar storms. That would give the potential victims a day to plan, another day to put the plan into action and a third day as a safety margin.

Alexander Kosovichev, a senior research physicist in Scherrer's research group, also participated in the research.

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Stanford University**. The original article was written by Louis Bergeron.

Journal Reference:

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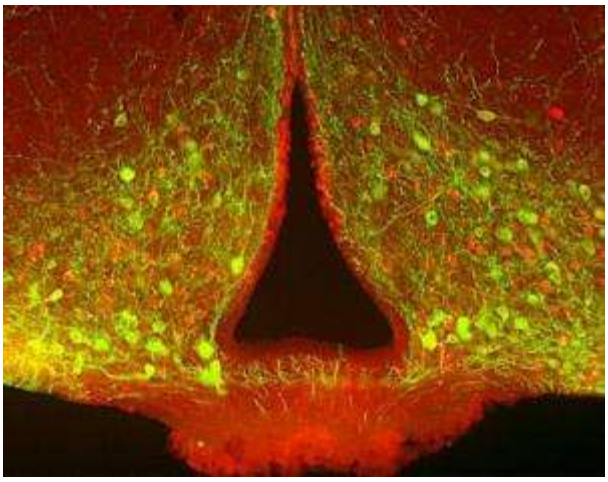
http://www.sciencedaily.com/releases/2011/08/110819141524.htm

Free Radicals Crucial to Suppressing Appetite



This image shows satiety promoting melanocortin neurons (green) in the hypothalamus, some of which are activated (red nuclei) after treatment. (Credit: Tamas Horvath, Yale University)

ScienceDaily (Aug. 29, 2011) — Obesity is growing at alarming rates worldwide, and the biggest culprit is overeating. In a study of brain circuits that control hunger and satiety, Yale School of Medicine researchers have found that molecular mechanisms controlling free radicals -- molecules tied to aging and tissue damage -- are at the heart of increased appetite in diet-induced obesity.

Published Aug. 28 in the advanced online issue of *Nature Medicine*, the study found that elevating free radical levels in the hypothalamus directly or indirectly suppresses appetite in obese mice by activating satiety-promoting melanocortin neurons. Free radicals, however, are also thought to drive the aging process.

"It's a catch-22," said senior author Tamas Horvath, the Jean and David W. Wallace Professor of Biomedical Research, chair of comparative medicine and director of the Yale Program on Integrative Cell Signaling and Neurobiology of Metabolism. "On one hand, you must have these critical signaling molecules to stop eating. On the other hand, if exposed to them chronically, free radicals damage cells and promote aging."

"That's why, in response to continuous overeating, a cellular mechanism kicks in to suppress the generation of these free radicals," added lead author Sabrina Diano, associate professor of Ob/Gyn, neurobiology and comparative medicine. "While this free radical-suppressing mechanism -- promoted by growth of intracellular organelles, called peroxisomes -- protects the cells from damage, this same process will decrease the ability to feel full after eating."

After the mice ate, the team saw that the neurons responsible for stopping overeating had high levels of free radicals. This process is driven by the hormone leptin and glucose, which signal the brain to modulate food intake. When mice eat, leptin and glucose levels go up, as does free radical levels. However, in mice with diet-induced obesity, these same neurons display impaired firing and activity (leptin resistance); in these mice, levels of free radicals were buffered by peroxisomes, preventing the activation of these neurons and thus the ability to feel sated after eating.

According to Horvath and Diano, the crucial role of free radicals in promoting satiety as well as degenerative processes associated with aging may explain why it has been difficult to develop successful therapeutic strategies for obesity without major side effects. Current studies address the question of whether, under any circumstance, satiety could be promoted without sustained elevation of free radicals in the brain and periphery.

The study was supported by grants form the National Institutes of Health and the American Diabetes Association.

Story Source:

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

Journal Reference:

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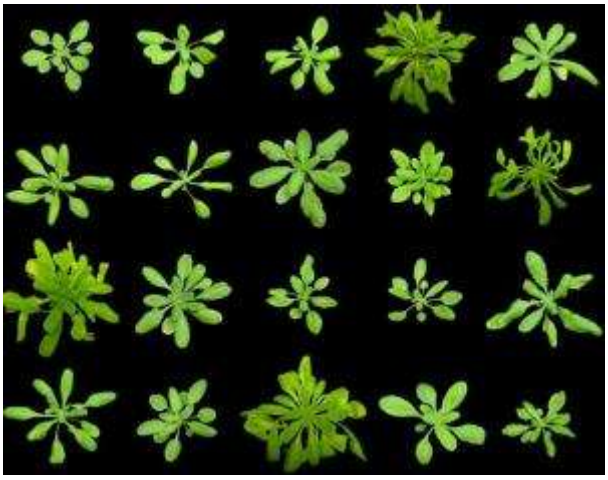
http://www.sciencedaily.com/releases/2011/08/110828140931.htm

Arabidopsis: Thanks to Its Flexible Genome, the Plant Can Adapt to Various Environmental Conditions



Different mutants of Arabidopsis thaliana. (Credit: Copyright Detlef Weigel/MPI f. Developmental Biology)

ScienceDaily (Aug. 28, 2011) — People can develop new technologies and animals may migrate to other regions. However, plants are tied to their location. Nevertheless, they have found ways to ensure their survival. This is the case for the plant *Arabidopsis thaliana*, which is found throughout the entire northern hemisphere. But how does this small, inconspicuous plant deal with all these different extremes?

In order to discover the whole-genome sequence variation, the 1001 Genomes Project was launched in 2008, with eleven research institutes participating worldwide. By investigating the genetic material of about one hundred strains of this plant from different geographical regions, researchers found a huge number of variations: in addition to millions of small differences that lead to a diversity of molecular gene products, they found hundreds of genes that are missing in some strains or have extra copies in others. It is probably this great flexibility within the genetic material that makes this plant particularly adaptable. In the medium term the complete catalog of the genome and gene product variation of a species can be applied to modern plant breeding.

Which genes and gene variants allow different individuals of one species to thrive under very different environmental conditions? The model plant for genetics, the thale cress, *Arabidopsis thaliana*, is especially well suited for the investigation of this question. It can deal with heat and drought in northern Africa as well as with cold in the central Asian highlands and temperate zones in Europe. Depending on the region it may display extensive foliage or appear small and fragile, yet it is always the same species. The answer lies without doubt in the diversity of its genetic material. Detlef Weigel and Karsten Borgwardt from the Max Planck Institute for Developmental Biology, Gunnar Rätsch from the Friedrich Miescher Laboratory in Tübingen, and Karl Schmid of the University of Hohenheim have, together with an international team, sequenced and analyzed the genome of different *Arabidopsis* strains from all over Europe and Asia. To reveal the effect of geographic distance on the genes they selected plants from strains growing locally -- in the Swabian Neckar Valley -- as well as plants growing at opposite ends of the plant's distribution area, such as North Africa or Central Asia.

By sequencing nearly 100 genomes of different strains, the scientists hope to obtain a fundamental scientific understanding of evolution. The resulting information should pave the way for a new era of genetics in which alleles underpinning phenotypic diversity across the entire genome and the entire species can be identified. The scientists have found that thousands of proteins differ in their structure and function in the different *Arabidopsis* strains. In addition, they found several thousand cases of extra copies of genes, gene loss, as well

as new genes that were previously only found in other plant species. "Our results show very impressively just how pronounced the genetic variability is," says Jun Cao from the Max Planck Institute for Developmental Biology and first author of one of the projects. Karl Schmid of the University of Hohenheim adds: "Adaptation through new mutations is very rare. More important is the recombination of already existing variants. With the information from more than a hundred genomes, not only can we make statements about these hundred individuals, but have thus laid the foundations to predict the genetic potential which could be realized by crossing particular individuals."

The geneticists working with Detlef Weigel, Karsten Borgwardt and Karl Schmid also found that the level of genetic variation differs widely between different regions. The researchers found the greatest genetic diversity in the Iberian Peninsula, where the plants have existed for a very long time. In Central Asia, which was only colonized after the last ice age, the *Arabidopsis* plants have relatively uniform genomes. Moreover, these populations have an above-average number of mutations that cause disadvantages for the plant, since protein functions are changed. Normally, natural selection removes these mutations over time, but in young emigrant populations they are enriched through cases of random evolution. "Figuring out how the plants and their genomes adapt to their environment is like a puzzle," says Jun Cao. "We need to collect all the pieces, before we can fit them together." The scientists have managed to create a nearly complete catalog of the genome variation of a species.

But how do these variations interact at the molecular level and what changes do they cause in the gene products? The computational biologist Gunnar Rätsch from the Friedrich Miescher Laboratory examined these questions in detail in a second study together with his international colleagues. They analyzed 19 strains of *Arabidopsis* with a particularly large genetic variability. These 19 individuals formed the basis of an artificial population of several hundred strains, created through multiple crosses such that different genome segments were shuffled systematically. The resulting individuals are ideally suited for examining gene interactions.

The scientists studied the genome segments using novel analysis methods of analysis and discovered in detail how DNA is read in detail and how the intermediate stage of protein production, the RNA, is produced. The researchers obtained detailed insight into the altered gene products arising from the various genomic variants. Depending on the genomic context some gene segments were either shut down or reactivated. "We can find a surprising number of changes affecting a single gene. However, they are often compensated for and therefore often have no significant effect on the gene products," says Gunnar Rätsch about the new results. The concepts, methods and platforms developed based on the genomic variation of *Arabidopsis thaliana* can also be used to study crop plants and for fast and accurate mapping of desirable characteristics. In addition, researchers can transfer this understanding about the influence of variation on gene products and their interactions to studies of the human genome.

These new projects should be viewed in the context of the 1001 Genomes Project, which was launched in 2008 at the Max Planck Institute for Developmental Biology and is being implemented through many individual projects in cooperation with ten other institutions worldwide. The aim is to analyze and compare the genes of 1001 different *Arabidopsis* strains. The goal of this large-scale project is to obtain fundamental insights into evolution, genetics and molecular mechanisms. Almost 500 different genomes have already been sequenced and analyzed at the different institutions. The data is being fed into a public database, which can be accessed not only by participants of the projects, but by all interested scientists.

Story Source:

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

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http://www.sciencedaily.com/releases/2011/08/110828140953.htm

Earth-Bound Asteroids Come from Stony Asteroids, New Studies Confirm

This is a Hayabusa capsule landed at Woomera in South Australia. (Credit: Image copyright JAXA/ISIS)

ScienceDaily (Aug. 26, 2011) — Researchers got their first up-close look at dust from the surface of a small, stony asteroid after the Hayabusa spacecraft scooped some up and brought it back to Earth. Analysis of these dust particles, detailed in a special issue of the journal *Science* this week, confirms a long-standing suspicion: that the most common meteorites found here on Earth, known as ordinary chondrites, are born from these stony, or S-type, asteroids. And since chondrites are among the most primitive objects in the solar system, the discovery also means that these asteroids have been recording a long and rich history of early solar system events.

The 26 August issue of *Science* includes six reports and a Perspective article that highlight the initial studies of this asteroid dust.

The Hayabusa spacecraft was launched by the Japan Aerospace Exploration Agency (JAXA) in 2003 to sample the surface of the near-Earth asteroid known as 25143 Itokawa. The unmanned vessel reached its destination a little more than two years later -- and in November 2005, it made two separate touchdowns on the surface of Itokawa. Although its primary sampler malfunctioned, the spacecraft was able to strike the asteroid's surface with an elastic sampling horn and catch the small amount of dust particles that were kicked up. After reentering Earth's atmosphere and landing in South Australia in June 2010, Hayabusa's delicate samples were analyzed extensively by various teams of researchers.

"*Science* is very excited and pleased to be presenting these important scientific analyses," said Brooks Hanson, Deputy Editor of the Physical Sciences. "The first samples that researchers collected beyond Earth were from the moon, and the first analyses of those samples were also published in *Science*. Those samples, along with the more recent sampling of a comet and the solar wind, have changed our understanding of the solar system and Earth. They are still yielding important results. These Hayabusa samples are the first samples of an asteroid. Not only do they provide important information about the history of the asteroid Itokawa, but by providing the needed ground truth that is only possible through direct sampling, they also help make other important samples -- like meteorite collections and the lunar samples -- even more useful."

The asteroid sampled by Hayabusa is a rocky, S-type asteroid with the appearance of a rubble pile. Based on observations from the ground, researchers have believed that similar S-type asteroids, generally located in our solar system's inner and middle asteroid belt, are responsible for most of the small meteorites that regularly strike Earth. But, the visible spectra of these asteroids have never precisely matched those of ordinary chondrites -- a fact that has left researchers suspicious of their actual affiliation. The only way to confirm a

direct relationship between meteorites and these S-type asteroids was to physically sample the regolith from an asteroid's surface.

Tomoki Nakamura from Tohoku University in Sendai, Japan and colleagues from across the country and in the United States were among the first to analyze this regolith brought back by Hayabusa. The team of researchers used a combination of powerful electron microscopes and X-ray diffraction techniques to study the mineral chemistry of Itokawa's dust particles.

"Our study demonstrates that the rocky particles recovered from the S-type asteroid are identical to ordinary chondrites, which proves that asteroids are indeed very primitive solar system bodies," said Nakamura.

The researchers also noticed that Itokawa's regolith has gone through significant heating and impact shocks. Based on its size, they conclude that the asteroid is actually made up of small fragments of a much bigger asteroid.

"The particles recovered from the asteroid have experienced long-term heating at about 800 degrees Celsius," said Nakamura. "But, to reach 800 degrees, an asteroid would need to be about 12.4 miles (20 kilometers) in diameter. The current size of Itokawa is much smaller than that so it must have first formed as a larger body, then been broken by an impact event and reassembled in its current form."

Separate teams of researchers, including Mitsuru Ebihara from Tokyo Metropolitan University and colleagues from the United States and Australia, cut open the tiny regolith grains returned by Hayabusa to get a look at the minerals inside them. Their composition shows that the dust grains have preserved a record of primitive elements from the early solar system. Now, those mineral compositions can be compared to tens of thousands of meteorites that have fallen to Earth, and then correlated to the visible spectra of other asteroids in space.

Akira Tsuchiyama from Osaka University in Toyonaka, Japan and colleagues from around the world also analyzed the three-dimensional structures of the dust particles. Since dust from the surface of the moon is the only other type of extraterrestrial regolith that researchers have been able to sample directly (from the Apollo and Luna missions), these researchers closely compared the two types.

"The cool thing about this Itokawa analysis is the tremendous amount of data we can get from such a small sample," said Michael Zolensky from the NASA Johnson Space Center in Houston, Texas, a co-author of the research. "When researchers analyzed regolith from the moon, they needed kilogram-sized samples. But, for the past 40 years, experts have been developing technologies to analyze extremely small samples. Now, we've gained all this information about Itokawa with only a few nano-grams of dust from the asteroid."

According to the researchers, Itokawa's regolith has been shaped by erosion and surface impacts on the asteroid, whereas lunar regolith, which has spent more time exposed to solar winds and space weathering, has been more chemically altered.

Takaaki Noguchi from Ibaraki University in Mito, Japan, and colleagues cite this chemical difference between the lunar dust and the Itokawa samples as one of the reasons astronomers have never been able to definitively tie ordinary chondrites to S-type asteroids in the past.

"Space weathering is the interaction between the surface of airless bodies, like asteroids and the moon, and the energetic particles in space," said Noguchi. "When these energetic particles -- like solar wind, plasma ejected from the Sun and fast-traveling micrometeoroids -- strike an object, pieces of them condense on the surface of that object. In the vacuum of space, such deposits can create small iron particles that greatly affect the visible spectra of these celestial bodies when they are viewed from Earth."

But now, instead of using lunar samples to estimate the space weathering on an asteroid in the future, researchers can turn to the asteroid regolith for direct insight into such processes.

Two more international studies led by Keisuke Nagao from the University of Tokyo and Hisayoshi Yurimoto from Hokkaido University in Sapporo, Japan, respectively, have determined how long the regolith material has been on the surface of Itokawa and established a direct link between the oxygen isotopes in ordinary chondrites and their parent, S-type asteroids.

According to the researchers, the dust from Itokawa has been on the surface of the asteroid for less than eight million years. They suggest that regolith material from such small asteroids might escape easily into space to become meteorites, traveling toward Earth.

"This dust from the surface of the Itokawa asteroid will become a sort of Rosetta Stone for astronomers to use," according to Zolensky. "Now that we understand the bulk mineral and chemical composition of the Hayabusa sample, we can compare them to meteorites that have struck the Earth and try to determine which asteroids the chondrites came from."

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The report by Ebihara *et al.* received additional support from a grant-in-aid defrayed by the Ministry of Education, Culture, Science and Technology of Japan and a grant from NASA.

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The report by Tsuchiyama *et al.* received additional support from a grant-in-aid of the Japan Ministry of Education, Culture, Sports, Science and Technology and the NASA Muses-CN/Hayabusa Program.

Story Source:

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

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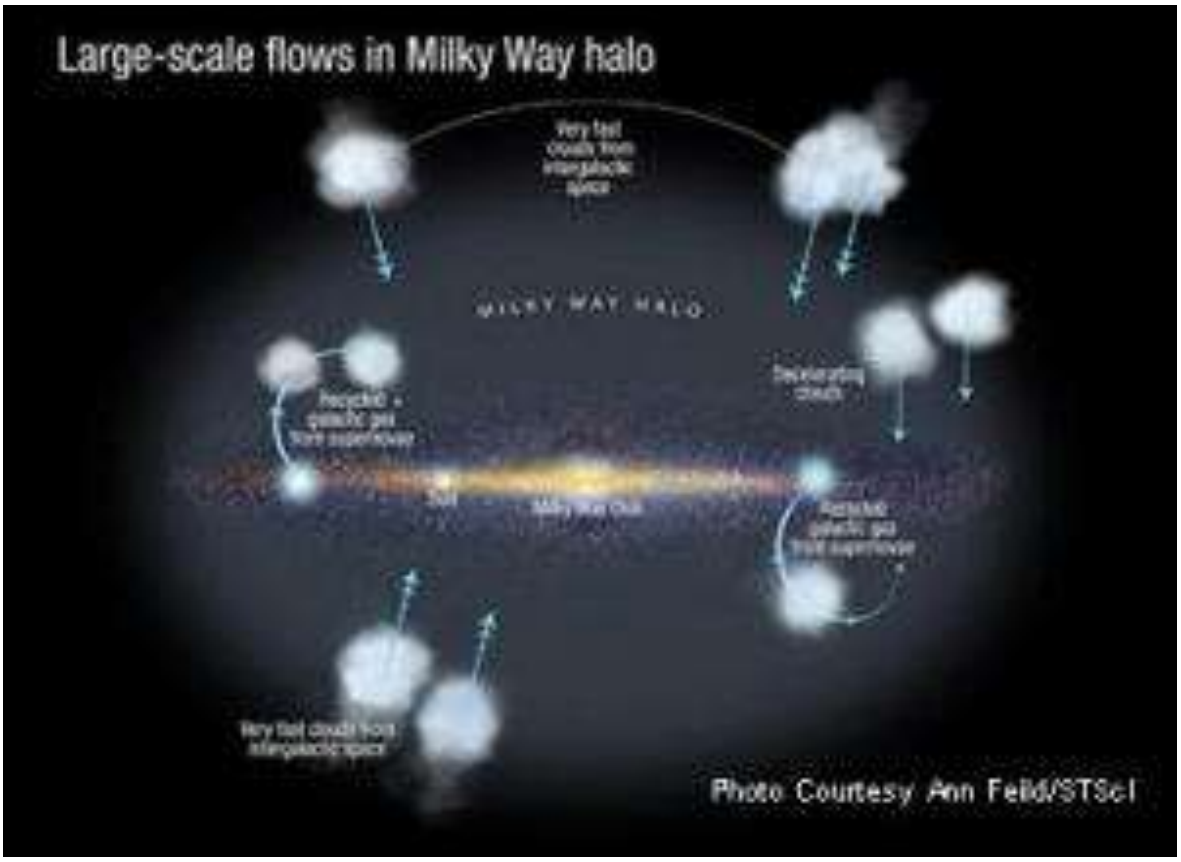
Milky Way's Halo Raining Ionized Gas to Fuel Continued Star Formation



Large scale flows in Milky Way halo. (Credit: Image courtesy of University of Notre Dame)

ScienceDaily (Aug. 26, 2011) — The Milky Way will have the fuel to continue forming stars, thanks to massive clouds of ionized gas raining down from its halo and intergalactic space. This is the conclusion of a new study by Nicolas Lehner and Christopher Howk, faculty in the Department of Physics at the University of Notre Dame.

Their report was published in *Science* on Aug. 26.

Using the Cosmic Origins Spectrograph, one of the newest instruments on the NASA/ESA Hubble Space Telescope, these researchers measured for the first time the distances to fast-moving clouds of ionized gas previously seen covering a large fraction of the sky. These fast-moving clouds reside in the distant reaches of the Milky Way and contain huge quantities of gas.

The Milky Way would rapidly change its gas into stars if no supply of new matter were available to replenish the gas. Astronomers have hypothesized that the ionized fast-moving gas clouds could be this reservoir of gas, but it was not known if they were interacting with the Milky Way.

"Our findings explain why the Milky Way can keep having star formation," Lehner says. "Knowing the distances to these clouds tells us where the gaseous fuel is for forming stars over billions of years."

Gas clouds can be identified and studied because elements in the cloud absorb small amounts of the light from a star or other light source as it passes through a cloud on its way to Earth. The characteristic "fingerprint" left in the spectrum allows astronomers to determine the properties of the gas.

Star Formation in the Milky Way

Earlier studies of these fast-moving ionized clouds used light from quasars, which are too far away to mark the clouds' locations. To solve the problem, Lehner and Howk identified 27 stars around the Milky Way, whose distances were known, and used the Hubble to take line-of-sight readings of light coming from them.

Results from the stellar sample showed the ionized clouds largely resided in the Milky Way's halo. The authors concluded that these flows of ionized gas are within about one Galactic radius (40,000 light years) of Earth. The new Hubble observations revealed the presence of ionized gas in half the stellar sample, comparable to the fraction observed toward more distant quasars.

The gas clouds are not uniformly distributed around the Galaxy, but rather collected in different areas. They cover only part of our Galactic sky, analogous to the partial coverage of the sky on a partly cloudy day on Earth. This research also confirmed models that predicted gas falling into the Milky Way slows as it approaches. Clouds closer to the Galaxy seem to have been decelerated and do not move as fast as those farther away, much like a meteorite slowing as it enters Earth's atmosphere.

"We know now where is the missing fuel for Galactic star formation." Lehner concludes. "We now have to learn how it got there."

Story Source:

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

Journal Reference:

1. Nicolas Lehner and J. Christopher Howk. **A Reservoir of Ionized Gas in the Galactic Halo to Sustain Star Formation in the Milky Way**. *Science*, 25 August 2011 DOI: 10.1126/science.1209069

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Simple Way to Grow Muscle Tissue With Real Muscle Structure

Researcher Dr. Daisy van der Schaft of Eindhoven University of Technology working on the preparation of muscle tissue cultures. (Credit: Eindhoven University of Technology/Bart van Overbeeke)

ScienceDaily (Aug. 26, 2011) — Researchers at Eindhoven University of Technology (TU/e) have found a simple way to grow muscle tissue with real muscle structure in the laboratory. They found that the muscle cells automatically align themselves if they are subjected to tension in one direction -- this is essential for the ability of the muscle cells to exert a force. The endothelial (blood vessel) cells in the culture also automatically grouped themselves to form new blood vessels. This finding is a step forward towards the engineering of thicker muscle tissue that can for example be implanted in restoration operations.

The results were published in the scientific journal *Tissue Engineering Part A.*

Another important aspect of the finding is that it was not necessary to add any biochemical growth factors to initiate the process. These substances are normally required for processes of this kind, but their action is difficult to control, according to TU/e researcher Dr. Daisy van der Schaft.

Disorganized

Other researchers have also succeeded in engineering muscle tissue containing blood vessels, but in these cases the muscle cells and blood vessels were disorganized. To give the muscles their strength, all the muscle cells need to be aligned in the same direction. Additionally, the muscles need blood vessels to supply them with oxygen and nutrients.

Tension

The TU/e research team produced engineered muscle tissue from a mixture of precultured stem cells and blood vessel cells (both from mice) in a gel. They then fastened the pieces of cultured tissue, measuring 2 x 8 mm, in one direction using pieces of Velcro. The stem cells then changed into muscle cells. This process normally involves shrinkage of the tissue. However, because the tissue was fastened this shrinkage was prevented, and the resulting tension caused the muscle cells to become aligned during the culturing process. This alignment is essential for the muscles to be able to exert a force.

Growth factors produced

In addition, the blood vessel cells organized themselves to form blood vessels, without the researchers needing to add any growth factors -- these were created automatically. Measurements by the researchers

showed that the muscle cells produced the required growth factor themselves, as a result of the tension to which they were subjected.

Thicker tissue

The formation of blood vessels is an important step to allow the engineering of thicker muscle tissue. Up to now the maximum thickness that could be achieved was 0.4 mm, because the cells must be located no further than 0.2 mm from a blood vessel or other source of nutrients to ensure that they receive sufficient oxygen. The blood supply through the blood vessels means that in the near future it will be possible to feed the engineered muscle tissue from within, making it possible to culture thicker tissue.

Not just cosmetic

The aim of the research is ultimately to allow the treatment of people who have lost muscle tissue, for example through accidents or surgery to remove tumors. "Just one example is the restoration of facial tissue," explains Van der Schaft. Using these engineered muscle tissues would not just be cosmetic, but would give function back to the tissue." She expects that this should be possible within the next ten years.

One of the following steps to achieve this is the engineering of thicker muscle tissue, which the TU/e researchers will start working on in the near future. The same techniques will also have to be applied on human cells. "Researchers at the University Medical Center Groningen have already started, in partnership with us, to engineer human muscle tissue," Van der Schaft concludes.

Story Source:

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

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1. Daisy W.J. van der Schaft, Ariane C.C. van Spreeuwel, Hans C. van Assen, Frank P.T. Baaijens. **Mechanoregulation of Vascularization in Aligned Tissue-Engineered Muscle: A Role for Vascular Endothelial Growth Factor**. *Tissue Engineering Part A*, 2011; 110811095013006 DOI: 10.1089/ten.tea.2011.0214

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New Fossils May Redraw Human Family Tree

By NICHOLAS WADE

An apelike creature with human features, whose fossil bones were discovered recently in a South African cave, is the most plausible known ancestor of archaic and modern humans, the scientists who discovered the fossils say.

The claim, if accepted, would radically redraw the present version of the human family tree, placing the new fossil species in the center. The new species, called Australopithecus sediba, would dislodge Homo habilis, the famous tool-making fossil found by Louis and Mary Leakey, as the immediate human ancestor.

Paleontologists agree that the new fossils, discovered by Lee Berger of the University of Witwatersrand in Johannesburg, are of great significance. But they do not necessarily agree with Dr. Berger's contention, published Thursday in five articles in Science, that the fossils are on the main line of human evolution. As is common in the field of paleoanthropology, the discoverer of a new fossil is seeking to place it on the direct line of human descent, while others are resisting that interpretation.

The new fossils are unusually complete. In addition to two skulls reported last year, researchers led by Dr. Berger have since retrieved an almost complete right hand, a foot and a pelvis. The bones are especially well preserved because their owners apparently fell into a deep cave and a few weeks later were swept into a sediment that quickly fossilized their bones. The rocks above the cave have gradually eroded away, bringing the fossils to the surface, where one was found by Dr. Berger's son, Matthew, in 2008.

The Australopithecenes fell into the cave 1.977 million years ago, according to dating based on the rate of decay of uranium in the rock layer that holds the fossils.

Because of the unusual completeness and preservation of the fossils, Dr. Berger and his colleagues have a wealth of evidence with which to buttress their claim that Australopithecus sediba is a transitional species between apelike humans and real humans. In the articles in Science, Dr. Berger's team describes novel combinations of apelike and humanlike features in the hand, foot and pelvis of the new species. The hand, for instance, is apelike because it has long, strong fingers suitable for climbing trees, yet is also humanlike in having a long thumb that in combination with the fingers could have held tools in a precision grip. A cast of the inside of the skull shows an apelike brain, but one that had taken the first step toward being reorganized on human lines.

This mixture of apelike and humanlike features shows that the new species was transitional between the australopithecines and humans, the researchers said at a press conference Wednesday. Given its age, Australopithecus sediba is just old enough to be the ancestor of Homo erectus, the first species that paleoanthropologists agree belonged to the human ancestry and which existed 1.9 million years ago.

Other paleontologists said the new fossils were of great significance for the light they throw on human evolution, but this is not because Australopithecus sediba is necessarily the direct ancestor of the human genus. Rather, the fossils show the richness of evolutionary experimentation within the australopithecine group.

"This is really exciting new material," said Ian Tattersall, a paleoanthropologist at the American Museum of Natural History. "I think it holds the possibility of flinging wide open the question of what Homo is."

The new fossils show that "a huge amount of evolutionary experimentation was going on at this time," Dr. Tattersall said. "Homo somehow emerged out this evolutionary ferment."

The sediba fossils are important as evidence of this experimentation, not because they are necessarily the ancestors of the human lineage that eventually evolved from the upright walking australopithecine apes. "If you take sediba as a metaphor for evolutionary change, it is a whole lot more powerful than the claim for direct ancestry," Dr. Tattersall said.

A similar view was taken by Bernard Wood, a paleoanthropologist at George Washington University. "I think these are some of the most interesting papers that have been published in recent years," Dr. Wood said. "But these are probably not the reasons the authors think they are interesting."

Dr. Wood placed little credence in Dr. Berger's arguments that Australopithecus is a direct ancestor of the human group, saying there was too little time for the small-brained, tree-climbing ape to evolve into the large-brained Homo erectus. More interesting, in his view, are the strange combinations of apelike and humanlike features that Dr. Berger's team has described. The new fossils display the modular way in which evolution operates: they have mostly known features but in novel combinations that have never been seen before.

"It's clear that though the hand has to be an integrated whole, the parts of the hand evolve as separate modules," Dr. Wood said. "You can pick a No. 3 thumb from five possible options, say, and pair it with a No. 2 medial wrist a No. 4 lateral wrist."

"My guess is that there some aspects of the hand and foot that are more evolvable than others, and not all of these combinations are adaptive," Dr. Wood continued. "We thought we'd seen all the combinations that were possible, but what sediba has shown us here is a bunch of combinations we haven't seen before."

Dr. Wood said that although he had read the five papers quickly "late at night over a glass of whisky," he believed they would prove to be "a watershed in our understanding of human evolution, even if only to demonstrate that things are pretty complex, and because of this it will be very difficult to link different fossils in an evolutionary sequence."

Both Dr. Wood and Dr. Tattersall were open to the idea that Homo habilis may not be the direct ancestor of the human line, as has been long believed. But instead of replacing Homo habilis with Australopithecus sediba, as Dr. Berger proposes, they see Dr. Berger's discovery as pointing to the great variety of australopithecine apes, from which it will be very difficult to select the particular species that gave rise to humans. Dr. Tattersall believes the leap to humans may have been brought about very suddenly, perhaps by a few critical genetic changes, which is why the transition is so hard to trace in the fossil record.

Dr. Wood praised Dr. Berger for describing the new fossils so quickly. Dr. Tattersall said that Dr. Berger had been "incredibly forthcoming" in giving other researchers access to his fossils instead of hoarding them for his private use, as other paleoanthropologists have been known to do.

"Unlike anything else I can remember in 40 years, they have already sent us full casts of the material they have described, and it's available to any researchers who want to see it," Dr. Tattersall said.

http://www.nytimes.com/2011/09/09/science/09fossils.html?_r=1&ref=science

Sound, the Way the Brain Prefers to Hear It

By GUY GUGLIOTTA

LOS ANGELES — There is, perhaps, no more uplifting musical experience than hearing the "Hallelujah" chorus from Handel's "Messiah" performed in a perfect space. Many critics regard Symphony Hall in Boston — 70 feet wide, 120 feet long and 65 feet high — as just that space.

Some 3,000 miles away, however, a visitor led into the pitch-blackness of Chris Kyriakakis's audio lab at the University of Southern California to hear a recording of the performance would have no way to know how big the room was.

At first it sounded like elegant music played in the parlor on good equipment. Nothing special. But as engineers added combinations of speakers, the room seemed to expand and the music swelled in richness and depth, until finally it was as if the visitor were sitting with the audience in Boston.

Then the music stopped and the lights came on. It turned out that the Immersive Audio Lab at U.S.C.'s Viterbi School of Engineering is dark, a bit dingy, and only 30 feet wide, 45 feet long and 14 feet high.

Acousticians have been designing concert halls for more than a century, but Dr. Kyriakakis does something different. He shapes the sound of music to conform to the space in which it is played. The goal is what Dr. Kyriakakis calls the "ground truth" — to replicate the original in every respect. "We remove the room," he said, "so the ground truth can be delivered."

Dr. Kyriakakis, an electrical engineer at U.S.C. and the founder and chief technical officer of Audyssey Laboratories, a Los Angeles-based audio firm, could not achieve his results without modern sound filters and digital microprocessors.

But the basis of his technique is rooted in the science of psychoacoustics, the study of sound perception by the human auditory system. "It's about the human ear and the human brain, and understanding how the human ear perceives sound," Dr. Kyriakakis said.

Psychoacoustics has become an invaluable tool in designing hearing aids and cochlear implants, and in the study of hearing generally. "Psychoacoustics is fundamental," said Andrew J. Oxenham, a psychologist and hearing expert at the University of Minnesota. "You need to know how the normally functioning auditory system works — how sound relates to human perception."

The field's origins date back more than a century, to the first efforts to quantify the psychological properties of sound. What tones could humans hear, and how loudly or softly did they need to be heard?

Pitch could be measured in hertz and loudness in decibels, but other phenomena were not so easily quantified. Human hearing can discern the movement of sound with a surprising degree of accuracy. It can distinguish timbre, the difference between a clarinet and a saxophone. It can remember patterns of speech, to immediately identify a friend in a phone call years after last hearing the voice. And a parent can effortlessly sift the sound of an infant's cry from the blare of a televised football game.

Finally there were the imponderables, things we do with our hearing simply because we can. "Everyone knows the sound of a bowling ball as it rolls down the alley," said William M. Hartmann, a Michigan State University physicist and former president of the Acoustical Society of America. "What is it about that sound that we can identify?"

For much of the 20th century, engineers devoted themselves to developing acoustical hardware like amplifiers, speakers and recording systems. After World War II, scientists learned how to use mathematical formulas to "subtract" unwanted noise from sound signals. Then they learned how to make sound signals without any unwanted noise.

Next came stereo. By recording two tracks, engineers could localize sound for the listener. "Simple enough," said Alan Kraemer, chief technological officer for SRS Labs, an audio company in Santa Ana, Calif. "If something's louder on one side, you'll hear it on that side."

But stereo had no real psychoacoustics. It created an artificial sense of space with a second track, but did so by dealing with only one variable — loudness — and enhanced human perception simply by suggesting that listeners separate their speakers.

The digital age changed all this, allowing engineers to manipulate sound in ways that had never been tried before. They could create sounds that had never existed, eliminate sounds they did not want and use constant changes in filter combinations to deliver sound to listeners with a fidelity that had never before been possible.

Digital technology has led to innovations that have been critical in improving sound reproduction, in tailoring hearing aids for individual patients and in treating hearing impairment and developing cochlear implants — tiny electronic devices linking sound directly to the auditory nerve of a deaf person.

"Hearing aids are not the same as glasses," said Dr. Oxenham, at the University of Minnesota. "It's never been just about hearing sound; it's also about understanding sound and separating it from background noise. We can help with microprocessors. Without them it would have been impossible."

Despite recent advances, however, psychoacoustics has shown engineers that they still have a long way to go. No machine can yet duplicate the ability of the human ear to understand a conversation in a crowded restaurant. People with cochlear implants have "a terrible time" with background noise, Dr. Oxenham said. They also have trouble with pitch perception and distinguishing the sounds of different instruments. "Hearing loops," which are transmitters that broadcast sound signals directly to a receiver in a hearing aid, are catching on in concert halls, places of worship and even subway booths.

"The technology is really being strained," said Dr. Hartmann, at Michigan State. Because of psychoacoustics, "we know so much more, and therefore we can do so much more," but "there is so much more to do."

One factor that slows the pace of innovation, Dr. Hartmann suggested, is that the human auditory system is "highly nonlinear." It is difficult to isolate or change a single variable — like loudness — without affecting several others in unanticipated ways. "Things don't follow an intuitive pattern," he said.

It was this anomaly, in part, that led Dr. Kyriakakis in the 1990s to venture into psychoacoustics. He, his U.S.C. film school associate Tomlinson Holman, and their students were trying to improve the listening qualities of a room by measuring sound with strategically placed microphones.

"Often our changes were worse than doing nothing at all," Dr. Kyriakakis recalled. "The mic liked the sound, but the human ear wasn't liking it at all. We needed to find out what we had to do. We had to learn about psychoacoustics."

The trick was to establish a baseline for what sounded best, and there was no guidebook. So Dr. Kyriakakis and his students went to Boston Symphony Hall in 1998 to conduct a series of sound tests and to record the "Messiah."

At that time, acousticians had long known that a shoebox-shaped concert hall like Boston's offered the best sound, but what was important for Dr. Kyriakakis was to know why the human ear and the human brain that processed the signal felt that way.

Back in Los Angeles, his team began a series of simple experiments. Listeners were invited into the labs to hear the Boston tests and music and to rate the sound, using a scale of 1 to 5. Researchers shifted the sound to different combinations of speakers around the room.

Statistics showed that speakers directly ahead, combined with speakers 55 degrees to either side of the listener, provided the most attractive soundstage. The "wide" speakers mimicked the reflection from the side walls of the concert hall by causing the sound to arrive at the listener's ears milliseconds after the sound from the front. Sound from other angles did not have as great an effect.

Next, the team asked listeners what combination of speakers gave the best impression of "depth of stage." Here again, statistics showed a clear preference for speakers in front of listeners and high above them. This sound — also slightly delayed — gave the ear and the human brain a sense of where the different instruments were on a bandstand.

With these results as his template, Dr. Kyriakakis founded Audyssey. His idea was to make dens and living rooms sound like concert halls and movie theaters. Microprocessors made it possible to filter sound to minimize distortion and add the delays that make the music sound nearly perfect to the human ear from anywhere in the room.

Audyssey's first product, MultEQ, started with a five-speaker configuration, but for a full concert-hall-like effect, it now offers what Dr. Kyriakakis calls an "11.2" system: three speakers in front of the listener; two

elevated speakers; two wides; two speakers slightly behind the listener, and two speakers directly in back. Audio-video receivers with Audyssey's latest MultEQ technology cost $1,000 to $2,000.

For the unsophisticated listener, top-of-the-line sound equipment by itself seems good enough, but it is not like the psychoacoustically adjusted version. A video of the Eagles singing "Hotel California" sounded nice to a visitor until Audyssey's hardware director, Andrew Turner, pointed out that there was no bass when the volume was low. He flicked a switch and the bass returned, enriching the music with startling effect.

"At the concert itself, where there was a big room with a lot of high-volume sound, you could hear the low tones," he said. "But here in the studio, your brain is filtering them out as irrelevant at low volume. So you have to restore them.

"It's pure psychoacoustics."

http://www.nytimes.com/2011/09/06/science/06sound.html?ref=science

When Wheels Pile Up: Plant a Bike; Save the City

By NEIL GENZLINGER

"In 1880, New York City removed 15,000 dead horses from its streets," the historians Joel Tarr and Clay McShane wrote in an essay called "The Centrality of the Horse to the Nineteenth-Century American City." Horse carcasses, they added, "were sometimes dumped with garbage into the bays or the rivers, often floating there or washing up on the beaches."

"In the late 1860s, an 'offal dock' stood at the foot of West 38th Street," the essay continued. "From there, the carcasses of horses as well as other dead animals and offal from the city's slaughter houses was either dumped in the bay or sent to a rendering plant." I bring this to your attention because of the bicycle mania that is sweeping this town. Mayor Michael R. Bloomberg has been on a personal mission to push bike ridership. Bike lanes have sprung up where none were before.

News coverage has focused on the immediate issues generated by the stampede to bicycles: pedestrian-vs.-cyclist wars in some neighborhoods; the sudden discovery by the police that cyclists can be ticketed just as motorists are. But never mind these tempests in teapots: I believe we have a looming bicycle-disposal crisis on our hands that has disastrous implications for our city. Happily, I also believe that Bernard Klevickas, an artist in Long Island City, Queens, has already solved it.

Historically, we have always had a problem with disposing of our used and obsolete transportation apparatus. There were those dead horses, a vexing issue up until the early part of the last century. (The aforementioned article says a streetcar horse had an average life expectancy of four years.) There are today's automobiles — all those cheery call-us-for-car-disposal services make it seem as if clunkers just vanish into a blissful, tax-deductible afterlife, but you don't have to drive far into the suburbs to come across choked junkyards or rusting truck carcasses next to run-down houses. And am I the only one who is suspicious of the finding that

old subway cars, when tossed into the ocean, make good artificial reefs? If ocean life wanted to live in subway cars, you'd see more fish and fewer rats in the A train tunnel. Already, the bicycle age is experiencing a disposal problem, though still a relatively minor one. You see deceased bikes — or, more often, pieces of bikes — all over the city, chained to poles or tossed in alleys. Maybe a perfectly good but inexpensive bike was parked by its owner and had its wheels stolen; rather than replace them, the owner just left the frame where it was. Maybe a bike gave up the ghost after long and honorable service, but its owner couldn't cram it into the trash can or figure out whether or how it fit into the city's indecipherable recycling rules.

Where you or I might see an eyesore in these discarded bikes, Mr. Klevickas, who works mostly in metal sculpture, sees opportunity. He has made some bike racks out of bicycle parts he has found around town, and more recently he has been displaying a spunky, funky bicycle planter on lampposts, guerrilla-style.

The artwork looks like a single bike that has had a too-close encounter with a truck — the wheels and frame are hideously bent. But it's actually a Frankenstein's-monster bike: Mr. Klevickas made it by welding together bicycle parts he had found. This creation, though, wasn't slapped together; first he designed a prototype on a computer, to make sure he had something that could be installed quickly but would give a wrap-around appearance.

"It would look like it couldn't be removed, but it could," he said, later demonstrating by taking the bicycle planter out to spend the night on a pole at 23rd Street and 41st Avenue near his studio in Long Island City, with a pot of yellow chrysanthemums in the holder.

The planter has logged time at other, fancier addresses: outside the Armory Show; in front of the New Museum. "I generally do abstract work," Mr. Klevickas said, the kind of sculpture that most people don't immediately get. "But this is different. People recognize it." They'll often do a double take. Because the bike-and-lamppost image is so ingrained in the urban mind, at first they'll register it as just another example. But then the mental processor throws up a flag — "this bike-and-post not matching others in memory banks" — and they'll look again. Many will then smile.

At the moment, there is only one bicycle planter, but Mr. Klevickas has ideas for more and a stack of beat-up bikes in his studio. Watching him chain the planter to that Long Island City pole on Tuesday night felt dangerous, as if I was party to something illegal. (And apparently I was; Mr. Klevickas said he had been fined once — $50 — for a planter placement, on the West Side of Manhattan.) But it also felt like a solution to our gathering bike-disposal crisis. I figure that when we transition to the all-bicycle transportation model, New York will go through bikes at roughly the same rate it used to go through horses. So those 15,000 dead horses a year from 1880 translate to 105,000 dead bicycles now, since the city has about seven times as many people as it did then.

Do we have 105,000 lampposts a year that need planters? Let's hope so, because otherwise we're going to have to follow the example of the people of Amsterdam (where the canals are choked with castoff bikes) and convince ourselves that the only thing fish enjoy more than swimming through rusting subway cars is frolicking amid rusting bicycles. Sounds like a fish story to me.

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Ariel Kaminer is on leave.

http://www.nytimes.com/2011/09/04/nyregion/when-wheels-pile-up-plant-a-bike-save-the-city.html?ref=design

Pass Complete: Tailgating Can Spawn Drinking Habits

New research links parental drunkenness at college football tailgating parties with alcohol abuse by their kids.

By Tom Jacobs

For a good number of tailgaters, drinking seems to be the game more than does football. (Photo by Brand X Pictures)

College football season has arrived, and many family-oriented fans will be taking their kids to a stadium this weekend. But if they robustly engage in a favorite pre-game ritual – alcohol-enhanced tailgating parties – team loyalty won't be the only thing they're passing down to the next generation.

Newly published research links parental inebriation at these parking-lot picnics with problem drinking by their college-student offspring. The sight of Mom or Dad drunk in this school- and sports-related context seems to send an uniquely powerful message.

"By perceiving their parents to be drunk at tailgates, students may learn to associate social or sporting events with heavy drinking," a research team led by Caitlin Abar writes in the *Journal of Adolescence.* "It is also possible that perceptions of parental drunkenness on campus are … easier to recall when making alcohol-related decisions."

The researchers studied a random sample of 290 freshmen at Penn State – where, they note, "over 100,000 people attend football games, and a large portion tailgates before and/or after the games." The students were first asked to estimate how often in the past year their father or mother had five or more drinks in a two-hour period. Then were then asked whether their parents attend tailgating parties, whether they drink at these gatherings, and whether they get drunk on such occasions.

The freshmen were then asked about their own drinking habits, including the number of drinks they have on a typical weekend (the average was 9.14), and the number of times they've gotten drunk in the past month (1.86 on average). Finally, they answered a set of 26 questions pertaining to negative consequences of alcohol abuse.

The students reported that 27 percent of their mothers and 46 percent of their fathers engaged in heavy episodic drinking in the past year. Forty-two percent reported that their parents tailgated; 38 percent said their parents drank at tailgating parties; and 21 percent said their parents got drunk at these events.

Not surprisingly, heavy drinking by parents (at least as perceived by their kids) was associated with higher levels of student drinking. But it appears not all parental drinking binges have the same impact on adolescents; for some reason, those that occur at tailgating parties are particularly predictive of trouble to come.

"When holding all other predictors constant, more frequent parental drunkenness at tailgates was associated with higher student weekend drinking, frequency of drunkenness, and experienced (negative) consequences," the researchers report. They add this association was "over and above the influence of more typical parental modeling."

The researchers aren't sure of the reasons for this. But it's easy to see how the unintended message that "college is a place where it's OK to get drunk" could come across loud and clear. Further exploration along these lines seems warranted, along with a two-pronged warning to parents: Kids mimic your behavior. And context matters.

http://www.miller-mccune.com/blogs/news-blog/pass-complete-tailgating-can-spawn-bad-drinking-habits-35786/

Writing's on the Wall (Art Is, Too, for Now)

By ROBIN FINN

THREE heavyset guys armed with aerosol canisters have their boombox tuned to a ribald talk-radio show as they transform a grungy section of wall in Long Island City, Queens, from a peeling mess to a psychedelic swirl of letters spelling out their names. The opposite of furtive, these tattooed artisans laugh as they brandish spraypaint cans for an audience of curious passers-by. Tagging may be illegal in New York, but not on this extraordinarily colorful industrial block beneath the shriek of the No. 7 subway line.

Farther along the street, a transit-themed mural includes a tongue-in-cheek four-star rating credited to Councilman Peter F. Vallone Jr., one of the city's most vocal critics of graffiti — or, as it is described by fans and practitioners, aerosol art. To them, this desolate site known as 5Pointz Arts Center is a mecca for graffiti artists, rappers and break-dancers from the five boroughs and beyond. Icons of the medium like Cope 2, Tats Cru and Tracy 168 have painted here, and musicians as diverse as Joss Stone and Jadakiss have shot videos using its garish walls as backdrop.

"These walls to me are no different than a canvas in a museum," said Jonathan Cohen, 38, an artist from Flushing. He is the primary guardian here, and the source of the billboard-size words painted on the main wall, "5Pointz: The Institute of Higher Burnin'." That his piercing eyes are worried and his dark hair infiltrated with gray is directly linked to recent statements by the building's owner that 5Pointz is living on borrowed time — destined to be replaced by two residential towers.

Since 2001, Mr. Cohen, whose nom de graffiti is meresone, has performed the role of on-premises curator, peacemaker and, in his vision, museum director. Permission to use the outside of the dilapidated warehouse, at 45-46 Davis Street, as a canvas was granted by the owner, Jerry Wolkoff, who also rented out makeshift art studio space until 2009, when a fire escape collapsed and seriously injured a jewelry artist. After the accident, the interior studios were dismantled and Mr. Wolkoff paid a fine for safety infractions, but the graffiti, monitored by Mr. Cohen, was allowed to continue, gratis.

Painters from France, Australia, Spain and elsewhere have been invited to make their mark on what some members of the urban arts frontier laud as an endangered landmark. The site is noted in foreign guidebooks as the hippest tourist attraction in Queens, an out-of-doors paean to street art. It is a headline attraction for Bike the Big Apple tours. But it lacks any mention on the local community board's list of cultural destinations, unlike the Museum of Modern Art's nearby PS1 outpost, which invited 5Pointz to perform at its summer arts series on Sunday, before Hurricane Irene forced a postponement. The taggers were to demonstrate their art on canvases, not on MoMA's walls.

At 5Pointz, a graffiti lovefest is celebrated daily in broad daylight and includes the prime display space up on the roof, where passing subway riders are treated to — or assaulted by — a striking portrait of the murdered rapper Notorious B.I.G. as interpreted by the New Zealand artist OD. Even the chairman of Community Board 2, Joe Conley, considers the mural "a magnificent example of creativity — it looks like a real painting."

On the flip side, he dismisses the building it is painted on as "a blight."

"People refer to it as 'that graffiti building,' not 'that arts center,' " he said. "It by and large has a negative connotation."

Mr. Conley and his board agree with the building's hitherto arts-friendly owner and developer, Mr. Wolkoff, that the moldering complex is ripe for razing in the name of urban development. Mr. Wolkoff envisions two 30-story apartment towers, and pledges to include affordable loft space for working artists. He also promises a rear wall accessible to graffiti artists.

"A rear wall? That won't cut it," objected Marie Flageul, an event planner who is part of a 10-person crew that acts as docents at 5Pointz. "It's like David and Goliath. What the landlord doesn't understand is that 5Pointz is a brand and an icon, and if he knocks it down it will be missed. 5Pointz is the United Nations of graffiti."

What Mr. Wolkoff proposes is two million square feet of development in a spot that currently houses 200,000 square feet of deteriorating warehouse decorated by an ever-mutating collection (aerosol art is not forever) of 350 murals and tags applied by a revolving cast of about 1,000 artists each year. There is no chance, he said, that the new project will be christened "Graffiti Towers." He's not that sentimental.

"There is an evolution going on in that part of Long Island City; the building is old, it doesn't warrant repairs, and no matter what, it has to come down," Mr. Wolkoff, 74, said in a telephone interview from Long Island, where he and his son own two business parks and are attempting to develop the decaying Pilgrim State psychiatric center site in Brentwood.

"It's time for me to put something else there," he said of 5Pointz. "It's a great location for young people and empty nesters who can't afford Manhattan." Mr. Wolkoff does not think the clatter of the No. 7 train will deter renters: "I can get you to 53rd and Fifth in 12 minutes!"

Supporters of this unlikely art temple are rallying to preserve it. An online petition called "Show Ur Love to 5Pointz" has accumulated more than 11,000 signatures and comments. The prevailing emotions: disbelief that the building will disappear and force graffiti artists back underground, and outrage that street art is again being censored.

On a recent Saturday, as Mr. Cohen was busily assigning another dozen spray-painters to several available sections of wall and roof, an assortment of fans and curiosity-seekers stopped by, some to gawk, others to pay their respects.

Jason Nickel, an art installer at PS1, brought his children, Lily, 12, and Jude, 8. “I heard the building might come down, and I was afraid the kids might not get to see it,” he said. “It’s a cultural landmark, actually.” Lily issued high praise. “It’s cool,” she said, twirling in front of a sinister mural by Christian Cortes.

Mr. Cortes, 38, abandoned his illegal spray-painting for a legal career in digital art in the mid-1990s, but after responding to an invitation from Mr. Cohen to visit 5Pointz and paint a wall, he found himself hooked again on creating graffiti tableaus.

“I got inspired as an old man to see what some of the young kids were doing here, carrying the flag for something that seemed to be disappearing,” Mr. Cortes said. “In other parts of the world, graffiti is accepted as an art form: here we are painting among Dumpsters on scraps of a building that’s going to be demolished, but because it’s legal, it feels like heaven. This is as good as it gets in New York.”

Don and Itta Ross, both 82, were in from Great Neck to scope out PS1 and 5Pointz. They found the graffiti “interesting.” They also lamented the lack of public art in New York City.

“New York is very backward in that respect,” Mr. Ross, a designer, said. “As long as this place isn’t hurting anybody, why not leave it alone? It’s a form of public art.”

http://www.nytimes.com/2011/08/28/nyregion/5pointz-arts-center-and-its-graffiti-is-on-borrowed-time.html

Going Green but Getting Nowhere

By GERNOT WAGNER

YOU reduce, reuse and recycle. You turn down plastic and paper. You avoid out-of-season grapes. You do all the right things.

Good.

Just know that it won't save the tuna, protect the rain forest or stop global warming. The changes necessary are so large and profound that they are beyond the reach of individual action.

You refuse the plastic bag at the register, believing this one gesture somehow makes a difference, and then carry your takeout meal back to your car for a carbon-emitting trip home.

Say you're willing to make real sacrifices. Sell your car. Forsake your air-conditioner in the summer, turn down the heat in the winter. Try to become no-impact man. You would, in fact, have no impact on the planet. Americans would continue to emit an average of 20 tons of carbon dioxide a year; Europeans, about 10 tons.

What about going bigger? You are the pope with a billion followers, and let's say all of them take your advice to heart. If all Catholics decreased their emissions to zero overnight, the planet would surely notice, but pollution would still be rising. Of course, a billion people, whether they're Catholic or adherents of any other religion or creed, will do no such thing. Two weeks of silence in a Buddhist yoga retreat in the Himalayas with your BlackBerry checked at the door? Sure. An entire life voluntarily lived off the grid? No thanks.

And that focuses only on those who can decrease their emissions. When your average is 20 tons per year, going down to 18 tons is as easy as taking a staycation. But if you are among the four billion on the planet who each emit one ton a year, you have nowhere to go but up.

Leading scientific groups and most climate scientists say we need to decrease global annual greenhouse gas emissions by at least half of current levels by 2050 and much further by the end of the century. And that will still mean rising temperatures and sea levels for generations.

So why bother recycling or riding your bike to the store? Because we all want to do something, anything. Call it "action bias." But, sadly, individual action does not work. It distracts us from the need for collective action, and it doesn't add up to enough. Self-interest, not self-sacrifice, is what induces noticeable change. Only the right economic policies will enable us as individuals to be guided by self-interest and still do the right thing for the planet.

Every ton of carbon dioxide pollution causes around $20 of damage to economies, ecosystems and human health. That sum times 20 implies $400 worth of damage per American per year. That's not damage you're going to do in the distant future; that's damage each of us is doing right now. Who pays for it?

We pay as a society. My cross-country flight adds fractions of a penny to everyone else's cost. That knowledge leads some of us to voluntarily chip in a few bucks to "offset" our emissions. But none of these payments motivate anyone to fly less. It doesn't lead airlines to switch to more fuel-efficient planes or routes. If anything, airlines by now use voluntary offsets as a marketing ploy to make green-conscious passengers feel better. The result is planetary socialism at its worst: we all pay the price because individuals don't.

It won't change until a regulatory system compels us to pay our fair share to limit pollution accordingly. Limit, of course, is code for "cap and trade," the system that helped phase out lead in gasoline in the 1980s, slashed acid rain pollution in the 1990s and is now bringing entire fisheries back from the brink. "Cap and trade" for carbon is beginning to decrease carbon pollution in Europe, and similar models are slated to do the same from California to China.

Alas, this approach has been declared dead in Washington, ironically by self-styled free-marketers. Another solution, a carbon tax, is also off the table because, well, it's a tax.

Never mind that markets are truly free only when everyone pays the full price for his or her actions. Anything else is socialism. The reality is that we cannot overcome the global threats posed by greenhouse gases without speaking the ultimate inconvenient truth: getting people excited about making individual environmental sacrifices is doomed to fail.

High school science tells us that global warming is real. And economics teaches us that humanity must have the right incentives if it is to stop this terrible trend.

Don't stop recycling. Don't stop buying local. But add mastering some basic economics to your to-do list. Our future will be largely determined by our ability to admit the need to end planetary socialism. That's the most fundamental of economics lessons and one any serious environmentalist ought to heed.

Gernot Wagner is an economist at the Environmental Defense Fund and the author of the forthcoming "But Will the Planet Notice?"

http://www.nytimes.com/2011/09/08/opinion/going-green-but-getting-nowhere.html?src=recg

Reading Fiction Impacts Aggressive Behavior

Researchers report that reading literature depicting aggression can impact how those readers respond to provocation.

By Tom Jacobs

New research suggests reading literature that has aggressive story lines can affect people's behavior in specific ways. (Hemera/Thinkstock.com)

A popular, narrative-driven form of entertainment — one that can be easily accessed via a variety of electronic devices — has been linked to aggressive behavior.

Violent video games? Well, sure. But newly published research points a finger at a much older art form: the written word.

"Reading aggression in literature can influence subsequent aggressive behavior, which tends to be specific to the type of aggression contained in the story," a Brigham Young University research team led by Sarah M. Coyne writes in the *British Journal of Social Psychology*.

The study does not show that reading a fictional account of an aggressive action increases belligerent behavior, but it suggests exposure to such literature has a psychological impact on readers, affecting the way they respond to provocations.

Coyne has conducted a series of interesting studies on aggression in pop culture, including a 2010 study of reality television — which, she found, contains more acts of aggression per hour than fictional programming. She notes that most research in this area has focused on television, movies or video games, ignoring the potential impact of the written word. Her team begins to rectify that with this paper.

Coyne divides aggression into two types: physical and "relational," which she defines as "behavior aimed at harming a person's relationships or social standing in the group." Slapping someone on the face is physical aggression; spreading nasty rumors about them is relational aggression.

She and her colleagues describe two experiments that use this distinction to demonstrate the impact of reading fiction.

In the first, 67 university students read a short story about a disagreement between a college freshman and her roommate. Half read a version in which the confrontation concludes with "a physical fight involving slapping, scratching, pushing and throwing objects." The others read an alternate ending, in which the aggrieved freshman "secretly records the roommate breaking some dorm rules and threatens to post the video on YouTube."

While reading the story on a computer screen, participants were interrupted by their "partner" (actually a computer program), who emailed them messages reading "Can u hurry up?" and "You're wasting my time!" After finishing the 1,200-word tale, they played a computer game with this annoying opponent, sounding a loud buzzer to indicate they had won a round.

"Participants who read the physical aggression story were more physically aggressive than those who read the relational aggression story," Coyne and her colleagues report. Specifically, they subjected their opponent to louder noise levels and maintained those levels for longer periods of time.

In other words, those who read a fictional description of physical violence were more likely to punish an irritating stranger by making him or her physically uncomfortable.

The second study used the same method as the first, except it measured relational aggression. After reading one or the other version of the story (and getting interrupted in the process), the 90 participants played a virtual ball-throwing game with their annoying opponent and an anonymous third party.

Those who had read the alternate ending, in which the aggressive roommate was threatened with being ostracized, effectively shunned their opponents, throwing the ball their way less frequently than those who had read the violent story.

In both cases, provoked people who were given the opportunity to engage in a specific form of retaliatory violence were more likely to do so if they had just read a fictional account of similar activity.

Again, this does not show that reading fiction increases aggressiveness. For the moment, at least, no one is comparing *Crime and Punishment* with *Grand Theft Auto*.

But the research suggests having a scene in our head can impact our subsequent behavior, and that scene needn't be conveyed in the form of eye-popping computer graphics. Descriptive prose will do quite nicely.

http://www.miller-mccune.com/culture/reading-fiction-impacts-aggressive-behavior-35839/

Doctor Fees Major Factor in Health Costs, Study Says

By ROBERT PEAR

WASHINGTON — Doctors are paid higher fees in the United States than in several other countries, and this is a major factor in the nation's higher overall cost of health care, says a new study by two Columbia University professors, one of whom is now a top health official in the Obama administration.

"American primary care and orthopedic physicians are paid more for each service than are their counterparts in Australia, Canada, France, Germany and the United Kingdom," said the study, by Sherry A. Glied, an assistant secretary of health and human services, and Miriam J. Laugesen, an assistant professor of health policy at Columbia.

The study, being published Thursday in the journal Health Affairs, found that the incomes of primary care doctors and orthopedic surgeons were substantially higher in the United States than in other countries. Moreover, it said, the difference results mainly from higher fees, not from higher costs of the doctors' medical practice, a larger number or volume of services or higher medical school tuition.

Such higher fees are driving the higher spending on doctors' services, the study concluded.

Ms. Glied, an economist, was a Columbia professor before President Obama named her assistant health secretary for planning and evaluation in June 2010. She said the paper, based on academic research, did not reflect the official views of the administration or the White House.

But the journal said the findings suggested that, as policymakers struggle to find ways to restrain health spending, they might consider doctors' fees. Doctors have generally been excluded from recent cost-cutting proposals because under existing law, Medicare, the federal insurance program for older people, will reduce their fees by 29.5 percent on Jan. 1. In addition, many states have frozen or reduced fees paid to doctors treating poor people under Medicaid.

The study examined fees paid by public programs and private insurers for basic office visits and for hip replacement surgery, and found that Americans were "very low users of office visits and relatively high users of hip replacement surgery."

"Fees paid by public payers to orthopedic surgeons for hip replacements in the United States are considerably higher than comparable fees for hip replacements in other countries," the authors found, "and fees paid by private insurers in the United States for this service are double the fees paid in the private sector elsewhere."

For primary care office visits, the gap between fees paid by Medicare and by public programs in other countries was smaller. But the study found that private insurers paid more for such services here than in other countries.

"U.S. primary care physicians earn about one-third more than do their counterparts elsewhere," mainly "because a much larger share of their incomes is derived from private insurance," the study said.

Ms. Laugesen and Ms. Glied said that among primary care doctors, those in the United States had the highest annual pretax earnings after expenses — an average of $186,582 in 2008 — while those in Australia and France had the lowest earnings, $92,844 and $95,585.

"Among orthopedic surgeons, those who had the highest annual pretax incomes, net of expenses, were in the United States," with an average of $442,450, the study said. In Britain, which ranked second, the comparable

figure was $324,138. Annual pretax earnings of orthopedic surgeons in the other countries were less than $210,000.

Medical students often cite higher pay as a reason for choosing to become specialists, and the researchers said the income gap between primary care doctors and orthopedic surgeons was larger here than elsewhere.

“In the United States, primary care doctors earned only about 42 percent as much as orthopedic surgeons earned,” the study said. “In Canada, France and Germany, in contrast, primary care doctors earned at least 60 percent as much as orthopedic surgeons earned.”

“High physician fees in the United States may reflect the cost of attracting skilled candidates to medicine in a society with a relatively more skewed income distribution,” the study said.

http://www.nytimes.com/2011/09/08/us/08docs.html?src=recg

America's Next Top Sociologist

A daylong photo shoot for *Vogue* pays only $150, women are like milk cartons, and other insights from the academic study of modeling.

By Libby CopelandPosted Wednesday, Sept. 7, 2011, at 1:06 PM ET

Ashley Mears wrote a sociological study of fashion models after being oneThere's a long tradition among academics of embedding in an occupation to study it. In the middle of the last century, social psychologist Marie Jahoda worked in an English paper factory to learn about about the lives of factory girls. More recently, sociologist Loïc Wacquant studied boxers by becoming one, while Sudhir Venkatesh spent seven years with a gang in the Chicago projects. One academic worked as a cotton picker, another entered prison as an inmate.

Ashley Mears embedded as a model. Then an NYU grad student in sociology, Mears had an idea what she was in for. She'd modeled in college, and knew that she still met the narrow physical requirements for the job. But this time around, she took notes after walking runways and attending casting calls. She interviewed other models as well as the industry tastemakers who hire them–agents, designers, magazine editors. Her new book, *Pricing Beauty*, offers a mostly grim picture of what's endured by those trying to make a living off their looks. Models are utterly dispensable, in Mears' telling: They labor at the mercy of inscrutable bosses, lousy pay, and punishing physical requirements. And for most of them, that's how the job will remain until they retire at the ripe old age of, say, 26.

Like actors and musicians, models work in a winner-take-all market, in which a few people reap rewards disproportionate to their talent, and everyone else scrapes by. This trend has become more exaggerated since the '90s, Mears writes, as the market has become glutted with young women from around the world, leading to greater turnover and plummeting pay rates. Would-be models are "scooped up, tried out, and spit out in rapid succession," she writes.

Through interviews, Mears investigated the financial state of the (unnamed) small modeling firm she worked for in Manhattan.* She found that 20 percent of the models on the agency's books were in debt to the agency.

Foreign models, in particular, seem to exist in a kind of indentured servitude, she writes, often owing as much as $10,000 to their agencies for visas, flights, and test shoots, all before they even go on their first casting call. And once a model does nab a job, the pay is often meager. Mears herself walked runways, sat for photo shoots for an online clothing catalog, modeled for designers in showrooms, and went on countless unpaid casting calls. During her first year of research she worked mornings, evenings, and weekends around her graduate classes and earned about $11,000.

Why do so many models operate against their own economic interests? Mears details how, in the fashion world, there is typically an inverse relationship between the prestige of a job and how much the model gets paid. A day-long shoot for *Vogue* pays a paltry $150, for instance, while a shoot for Britain's influential *i-D* magazine, which Mears calls "one of the most sought-after editorial clients for a model," pays absolutely nothing, not even the cost of transportation or a copy of the magazine for the model's portfolio.

The alternative to high-fashion poverty is to be a "money girl," working for catalogs and in showroom fittings, jobs that pay well and reliably. The best-paid model at Mears' agency, for instance, was a 52-year-old showroom model with "the precise size 8 body needed to fit clothing for a major American retailer. She makes $500/hour and works every day." But the commercial end of modeling is widely derided within the industry as low-rent, as mere work without glamour. Once a model has done too many commercial jobs, she is thought to have cheapened herself, and it's exceedingly difficult for her to return to high fashion.

So many models operate against their short-term interests, hoping that by investing time now they will hit pay dirt later in the form of fame and a high-paying luxury ad campaign. The catch is that there simply isn't much time to invest; the older a model gets, the more she "exudes failure," Mears writes. She quotes a 23-year-old model who'd been instructed by her agency to say she was 19: "They said it's like when you go to the grocery store to buy milk, which milk carton would you want, one that is going to expire tomorrow or one that will expire next week?"

The funny thing is that even though Mears knew the odds were against her, and despite her academic ambitions, she, too, found herself drawn in by the fantasy that the big time was just around the corner. In her mid-20s, she was ancient by industry standards, but she kept modeling for almost three years after her re-entry into the field, well after she had enough material for the dissertation that would later become this book. Each phone call she got from her booker, ordering her to hustle across town *right now* to a casting, felt like the phone call that might change her fate. (Which begs the question, if even Mears could be seduced by the industry, what chance does a poor girl from rural Brazil have?)

"It's the lottery," Mears told me recently over tea at a West Village coffee shop. Now 30, still lithe and luminous in that otherworldly model way, she's an assistant professor of sociology at Boston University. "You realize that the probability is slight but the possibility is so enticing."

There are a number of academics studying the modeling life right now. As a subject for scholarly study the topic may seem slight, but then again, there's been an explosion in what might be termed "girly" studies—looking at the work of strippers and Playboy bunnies, for instance—going back at least as far as the popularity of Madonna studies 20 years ago.

"I just got a request to review an academic paper of lap dancers," said Elizabeth Wissinger, a CUNY sociology professor who has interviewed models for her own book on the industry, which she's currently writing.

The title of Mears' book, *Pricing Beauty*, refers to her scholarly efforts to understand who or what determines a given model's chances of success in a field glutted with gorgeous people. How does this winner-take-all market produce winners? Why does one tall, underweight, astonishingly beautiful young woman become the face of Chanel No. 5, while another languishes, doing minor magazine shoots that pay little and never catapult

her to fame? Those in the industry like to imagine that there is something inevitable about the outcome. When Mears asked how they knew what made a winner, industry tastemakers explained that such models had an ineffable quality, a *je ne sais quoi*, that elevated them above the rest. "You know, *you just know*!" a stylist told Mears.

"It's like asking the meaning of life," a booker explained.

But as Mears discovers, the truth is that success in high-fashion modeling has a lot more to do with marketing and chance than it does with the ineffable. In a field saturated with models who have the right measurements and the right skin tone and the right "edgy" looks, bookers and casting agents and stylists and editors engage in a merry-go-round of imitation and blind guesswork, with everyone trying to anticipate what everyone else will like. Once a fresh new face is anointed, clients scramble to nab her for shoots and shows, proclaiming that they, too, see that special something. Mears likens the process to "The Emperor's New Clothes."

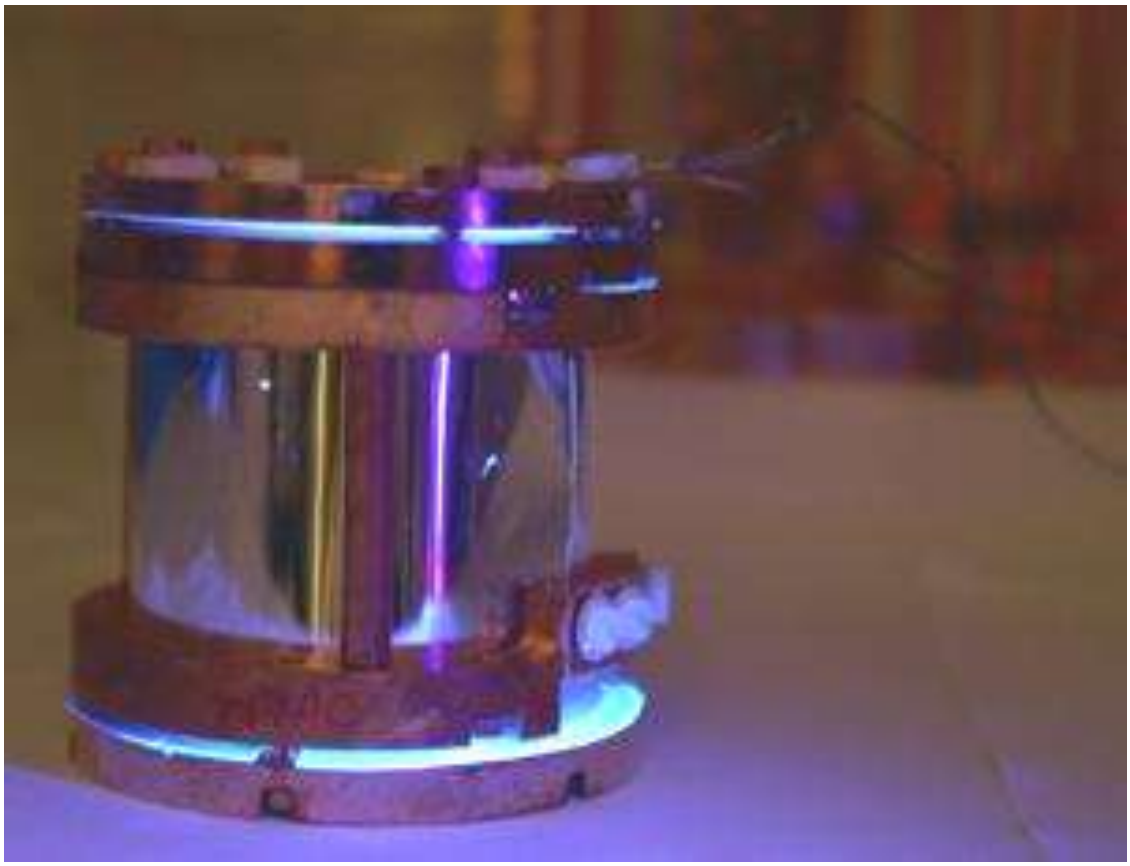
Becky Conekin, who teaches history at Yale and is studying what the modeling industry looked like in Great Britain during the middle of the 20th century, told me that her work is a "feminist project of recovery"—that taking models seriously is a way of taking women seriously, wherever we might find them. In a similar spirit, Mears' book, which is heavy on both economic analysis and tales of nobody strivers, gives voice to a group of women who are paid to be seen and not heard. Instead of focusing on the rise of the industry's few Coco Rocha-level superstars, she is interested in young women like Liz, whose story illuminates the very bad odds an aspiring model faces.* After dropping out of college to pursue her career, Liz spends years hustling for little pay in high fashion before finally succeeding in shampoo ads. But even then she is without health insurance. When she develops a stomach tumor, she must declare bankruptcy and move back in with her parents in New Jersey. There Mears finds her, at age 27, without a college degree, training to become a yoga teacher.

Mears' own foray into modeling has its own anticlimactic ending, a dismissal from her agency via a casual email (subject: "Hey Doll!!!"), offering little explanation. She gets one last check, for the grand sum of $150.

http://www.slate.com/id/2303242/

Third experiment sees hints of dark matter

- 13:02 07 September 2011 by **Stuart Clark**, Munich



Dark-matter detectors are buried deep beneath Gran Sasso (Image: Max Planck Institute)

A third experiment has detected tantalising signs of dark matter. The finding raises more questions than answers, however, as two other experiments have found no sign of the mysterious stuff, which is thought to create the gravity that holds spinning galaxies together, accounting for about 85 per cent of all matter in the universe.

The new result comes from an experiment called CRESST II, which uses a few dozen supercooled calcium tungstate crystals to hunt for dark matter from deep beneath the Gran Sasso mountain in Italy. When a particle hits one of the crystals, the crystal gives off a pulse of light, and sensitive thermometers gauge the energy of the collision.

The vast majority of hits come from garden-variety particles such as cosmic rays. These rain down on Earth from space in such large numbers that they strike CRESST II – which is shielded by a kilometre of rock – at a rate of about one per second. This shield should have little effect on dark-matter particles because they are thought to interact very weakly with normal matter.

Now researchers led by Franz Pröbst and Jens Schmaler of the Max Planck Institute for Physics in Munich, Germany, say the experiment detected around 20 collisions between June 2009 and last April that may not have been caused by known particles.

The collisions may have involved dark matter, says team member Federica Petricca, also of the Max Planck Institute. She reported the results yesterday at the Topics in Astroparticle and Underground Physics conference in Munich.

Particle minnows

If so, the energy measurements of the collisions can be fed into dark-matter models to produce estimates of the particles' mass. Using the leading theoretical model of dark matter, which posits that it is made of weakly interacting particles called neutralinos, the CRESST II result suggests they weigh between 10 and 20 gigaelectronvolts.

This is on the lighter end of previously predicted values, which fall between roughly 10 and 1000 GeV. The range is based on estimates of how many particles that ultimately decayed into neutralinos were created in the early universe.

Two other experiments have previously detected signs of low-mass dark matter. CoGeNT, located in a mine in Soudan, Minnesota, and DAMA, also buried inside Gran Sasso, have both seen signals interpreted as being caused by particle minnows with masses between 7 and 20 GeV.

But the new results conflict with two other dark-matter experiments, CDMS II, located in the Soudan mine, and XENON100 inside Gran Sasso. Both have seen no sign of dark matter at all.

New landscape?

CRESST II's 20 potential detections are not a strong enough finding to settle the confusion and claim a dark-matter detection – they could still be known particles such as cosmic rays. "We simply do not know enough yet to say anything conclusive. We need more data," says Belli Pierluigi of Italy's National Institute of Nuclear Physics in Rome, who is part of the DAMA group.

CRESST II team members will continue the experiment and hope to present more sensitive results next year. Rafael Lang, a member of the XENON100 team at Purdue University in Indiana, is eager to see them. "If their signal stays, that will be very interesting indeed," he says.

"The CREST II results and the apparent disagreements may be the first glimpses of something completely unexpected," he says. "It may be something totally new. Rather than dark matter, we could be seeing just the highest peaks of some extraordinary new physics landscape."The result closely follows one from NASA's FERMI satellite, which confirmed a hint that there is more antimatter than expected coming from space. Frustratingly, the result also ruled out previous suggestions that dark matter was the source.

Journal reference: arxiv.org/abs/1109.0702

http://www.newscientist.com/article/dn20875-third-experiment-sees-hints-of-dark-matter.html?full=true&print=true

10 Salient Studies on the Arts in Education

September 6th, 2011

A fine arts education — including music, theater, drawing, painting, or sculpture — whether in practice or theory, has been a part of any well-rounded curriculum for decades — but that may be changing. Many schools today are cutting back or eliminating their art programs due to budget constraints. It is estimated that by the end of this year, more than 25% of public high schools will have completely dismantled them. These stats aren't just bad news for teachers working in the arts. Numerous studies done over the past decade have demonstrated the amazing benefits of such an integral education facet. Students who don't have access to art classes may not only miss out on a key creative outlet, but might also face greater difficulty mastering core subjects, higher dropout rates and more disciplinary problems.

You don't have to take our word for it — you can read the studies yourself. Here, we've listed some of the biggest on the arts in education conducted over the past decade. Taken on by research organizations, college professors and school districts themselves, the studies reveal the power of art to inspire, motivate and educate today's students. And, of course, demonstrate what a disservice many schools are doing by undervaluing such an integral part of their education and development.

1. **A 2002 report by the Arts Education Partnership revealed that schoolchildren exposed to drama, music and dance are often more proficient at reading, writing, and math.**

   While school districts might be tempted to think the arts a frivolous part of the educational system, this report suggests otherwise. It looked at over 62 different studies from 100 researchers, spanning the range of fine arts from dance to the visual arts. In 2002, it was the first report of its kind to look at the impact of art on academic performance. Using this data, researchers determined that students who received more arts education did better on standardized tests, improved their social skills and were more motivated than those who had reduced or no access. While researchers at the AEP admitted that art isn't a panacea for what ails struggling schools, the study led them to believe it could be a valuable asset for teaching students of all ages — especially those in poor communities or who need remedial education.

2. **The 2006 Solomon R. Guggenheim Museum study on art education showed a link between arts education and improved literacy skills.**

   The study was the result of a pilot program through the Guggenheim called Learning Through Art, which sent artists into schools to teach students and help them create their own masterpieces. Kids who took part in the program performed better on six different categories of literacy and critical thinking skills than those who did not. While students did better on an oral exam, they did not on standardized, written literacy tests — a disparity researchers said could exist because they did not emphasize written communication in the program. Program organizers believe the improvements were the result of students learning valuable critical thinking skills while talking about art, which could then be applied to understanding and analyzing literary materials.

3. **In 2007, Ellen Winner and Lois Hetland published a study stating the arts don't actually improve academic performance, but it shouldn't matter.**

   Winner and Hetland head up an arts education program called Project Zero at the Harvard Graduate School of Education, so they are by no means opponents of creative expression. Yet in their 2000 study, they found little academic improvement in math, science, and reading in their arts education program enrollees. While the backlash from their report was swift and brutal, the researchers stuck by their findings. And for good reason. They believe it shouldn't matter whether or not art courses improve test scores or grades, and that art education should garner support for what it offers on its own merit — not in relationship to anything else. Regardless, their study did reveal that arts education has some larger benefits which can't be easily quantified through test scores. Namely, it helps students improve visual analysis skills, learn from mistakes, be creative and make better critical judgments.

4. **A 2005 report by the Rand Corporation called "A Portrait of the Visual Arts" argues that art education does more than just give students a creative outlet. It can actually help connect them to the larger world, ultimately improving community cohesion.**

   A bold assertion, but not one without merit. Students from lower income families often get little exposure to the arts if they are not provided by schools. The report shows that arts education can help close the gap between socioeconomic groups, creating a more level playing field between children who may not be exposed to these enrichment experiences outside of school and some of their more privileged peers.

5. **Teachers and students alike benefit from schools that have strong art climates, a 1999 study called "Learning In and Through the Arts" demonstrated.**

   People have been so wrapped up in showing how arts education benefits students, many haven't stopped to consider how it also impacts educators. The report studied students at 12 New York, Connecticut, Virginia and South Carolina schools to compile their results. Not only were students at schools with high levels of art education earning higher scores on critical thinking tests, but teachers also seemed happier. Part of the increase in their satisfaction was a result of their charges, who were found to be generally more cooperative and expressive and enjoy a better rapport with educators. That wasn't all, however, as teachers at schools that emphasized arts education enjoyed greater job satisfaction, were more interested in their work and likely to be innovative and pursued personal development experiences. It's not a trivial finding, as what is good for instructors is often very good for their students as well.

1. **<u>The Center for Arts Education published a report in 2009 that suggests arts education may improve graduation rates.</u>**

   Taking a look at the role of arts education in New York public schools, this report found that schools with the lowest access also had the highest dropout rates. Conversely, those with the highest graduation rates also had the greatest access to arts education and resources. While there are undoubtedly a number of other factors that play into graduation rates, the research in this study and others like it (most notably *The Role of the Fine and Performing Arts in High School Dropout Prevention*, which you can read here) has found that many at-risk students cite participation in the arts as their reason for staying. Participation in these activities has a quantifiable impact on levels of delinquency, truancy and academic performance.

2. **<u>A 2011 study called "Reinvesting in Arts Education" found that integrating arts with other subjects can help raise achievement levels.</u>**

   Arts education may not just help raise test scores, but also the learning process itself, as a recent study revealed. This report on the Maryland school system found that skills learned in the visual arts could help improve reading and the counterparts fostered in playing an instrument could be applied to math. Researchers and school officials believe that arts education can be a valuable education reform tool, and classroom integration of creative opportunities could be key to motivating students and improving standardized test scores.

3. **<u>A study of Missouri public schools in 2010 found that greater arts education led to fewer disciplinary infractions and higher attendance, graduation rates and test scores.</u>**

   Using data submitted by the state's public schools, the Missouri Department of Education and the Missouri Alliance for Arts Education compiled this report. They found that arts education had a significant effect on the academic and social success of their students. Those with greater arts participation were more likely to come to class, avoid being removed and graduate. Additionally, they demonstrated greater proficiency in mathematics and communication. Similar studies of other statewide education systems have discovered nearly identical results.

4. **In "Neuroeducation: Learning, Arts and the Brain," Johns Hopkins researchers shared findings showing that arts education can help rewire the brain in positive ways.**

   While proponents of arts education have long asserted that creative training can help develop skills translating into other areas of academics, little research had been done to investigate the scientific component. Aspects of training in the arts, like motor control, attention and motivation, were studied by researchers who participated in the report, with some interesting results. In one four-year study, students undertaking regular music training were found to have changes in their brain structures helping them transfer their motor skills to similar areas. Another found students motivated to practice a specific art form and spent time with focused attention increased the efficiency of their attention network as a whole, even when working in other areas of study — and it improved their fluid IQ scores. Other studies reported similar scientific findings on the arts' impact on the brain, showing that sustained arts education is can be essential part of social and intellectual development.

5. **A 2009 survey, part of the "Nation's Report Card: Arts 2008" report, found that access to arts education opportunities hasn't changed much in a decade.**

   Many of the problems that plagued arts education programs in schools ten years ago are still major issues today, this survey revealed. Middle school students across the nation haven't seen an increase in access to music and visual arts education, and their understanding of its tenets remains low — especially in certain disenfranchised socioeconomic and racial groups. Many believe the numbers are even worse today, as the survey was conducted prior to the economic woes that have paralyzed many schools systems in recent years. As in 1997, the 2008 survey showed that only 47% of students had access to visual arts education, and just 57% to music education. The survey attempted to look at theater and dance programs, but since so few schools offer them, they were dropped from the study.

http://www.onlinecolleges.net/2011/09/06/10-salient-studies-on-the-arts-in-education/

Giant Mars crater hints at steamy past

- 15:35 02 September 2011 by **David Shiga**

Opportunity knocks: the rover finds signs of water (Image: NASA/JPL-Caltech)

Modern Mars may be a frozen wasteland, but it has a hot and steamy past. NASA's Opportunity rover has started examining its most significant target yet, Mars's giant Endeavour crater. The initial results suggest the structure was once exposed to hot water.

Opportunity drove for three years before reaching the 22-kilometre-wide crater. Its rim exposes rocks from the earliest epoch of Martian history, when liquid water was abundant.

"We're looking at this phase of Opportunity's exploration as a whole new mission," says David Lavery of NASA Headquarters in Washington DC.

After arriving at the crater rim in early August, Opportunity investigated a rock about 1 metre across informally named Tisdale 2. It turns out to contain large quantities of zinc, more than in any other rock examined by Opportunity or its now defunct sister rover Spirit.

On Earth, hot water is known to sometimes contain a large quantity of dissolved zinc, which it can then deposit to form zinc-rich rocks. The zinc-rich rock on Endeavour's rim hints that hot water was once present

there too, possibly heated by the massive impact that formed the crater, according to rover chief scientist Steve Squyres of Cornell University in Ithaca, New York.

Bright veins

The rover team is still unsure about exactly what kind of environment the rock formed in, including whether the hot water was in liquid or vapour form.

Opportunity images have also revealed bright veins cutting through other rocks on the rim. These could be places where water flowed through cracks in the rock, leaving mineral deposits behind, although the rover has not yet measured their composition.

Before examining them, the rover is first heading along the crater rim to the north-east of Tisdale 2. Measurements from orbit suggest there are clay minerals in that direction, which require water to form.

Opportunity's handlers are relishing the prospect of exploring terrain that neither Mars rover has seen before. "The excitement level within the engineering and science teams is way up," says rover scientist Ray Arvidson of Washington University in St Louis, Missouri.

http://www.newscientist.com/article/dn20858-giant-mars-crater-hints-at-steamy-past.html

Class of Antipsychotics Ineffective in PTSD Treatment

The future may hold a drug therapy for treating post-traumatic stress disorder, but some of the popular choices of the last few years, like Risperdal, won't be part of it.

By Michael Scott Moore

A recent study claims that one class of antipsychotic is no better than a placebo for treating post-traumatic stress. (Istockphoto.com/stockxchange.com)

A new era of psychopharmacology combined with two wars in Asia has created its own surge in treating combat stress with prescription drugs. For tough cases doctors have even prescribed antipsychotics. But all drugs are not created equal, and a new study claims that one class of antipsychotic is no better than a placebo for treating post-traumatic stress.

The study underlines that there is no drug for PTSD symptoms. The researchers concentrated on one medication, Risperdal, but the results may apply to a whole class of antipsychotics that work on neurotransmission in the brain.

"It definitely calls into question the use of anti-psychotics in general for PTSD," Charles Hoge, a senior scientist at the Walter Reed Army Institute of Research, told *The New York Times*.

Antipsychotics like Risperdal target the way brain cells handle neurotransmitters like serotonin and dopamine. In that sense they're similar to antidepressants. They ease a symptom that might correspond to PTSD, but recent research indicates that combat stress can cause physical damage to the brain. The cells themselves may have changed shape or started to work in a different way.

Basically, antipsychotics may affect the brain on too shallow a level to help. But there might be hope for drugs that try to fix cells on a level closer to a person's genes.

"We don't understand the disorder well enough. All we have are puzzle pieces," says Dr. Ulrike Schmidt, a PTSD expert at the Max Planck Institute for Psychiatry in Munich. "But I can imagine that with more high-throughput experiments we will identify target genes, or the proteins they produce, which we can then try to steer with pharmaceuticals."

Her opinion is that the right genes or proteins might be found roughly "in the household of stress hormones," like cortisol.

Schmidt's research has shown that PTSD causes semi-permanent damage not only to parts of the brain, but also to the epigenome, the complex of molecules that surrounds a person's DNA and influences which genes are expressed. It's like a blow to a person's firmware — damage to a system that tells the body what to do. It's not irreversible, though a predisposition for it could be passed on to another generation.

Antipsychotics — widely prescribed as they are — may seem off the mark because psychosis itself is not a typical outcome of post-traumatic stress (the way depression is). But symptoms of psychosis and PTSD can overlap. And doctors have been prescribing antipsychotics "based almost entirely on their experience with them and how they expect them to work," according to the *Times*.

EUROPEAN DISPATCH

Michael Scott Moore complements his standing feature in Miller-McCune magazine with frequent posts on the policy challenges and solutions popping up on the other side of the pond.

The big caveat is that PTSD isn't well understood. And some vets may have been prone to certain psychoses to start with. The current study didn't select for them.

This research into molecules and brain behavior may wind up emphasizing that PTSD is too fine-grained and changeable to be treated entirely with drugs. As a disorder it seems to straddle the mysterious boundary between the mind and the brain. The simplest treatment — for most people — may still be sports, like surfing or biking, combined with talk therapy.

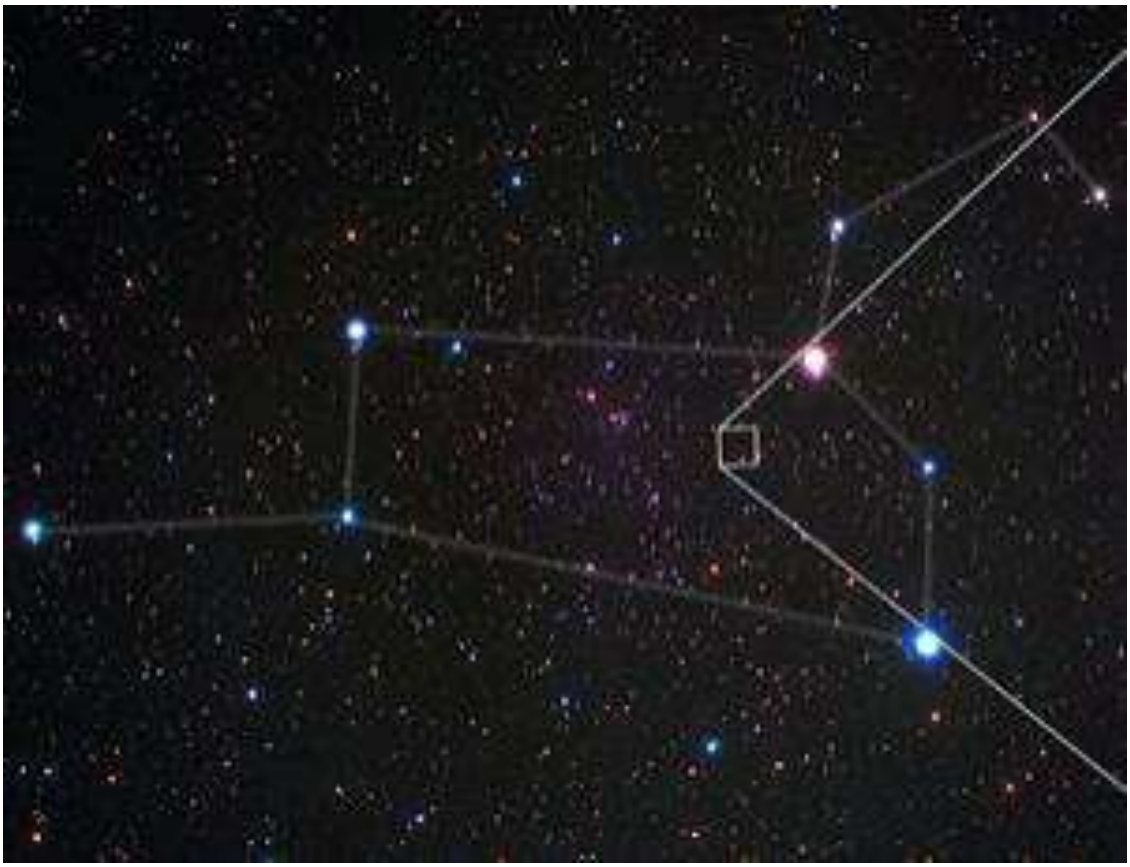
Schmidt helps run a clinic in Munich for people with severe post-traumatic stress, where the treatment involves drugs as well as therapy. "We have psychotherapy that includes depth psychology, gestalt therapy and behavioral-therapy elements. We never say, 'Only behavioral therapy is good' — we combine them. And we try to ease certain symptoms with medication. For example, a patient with severe sleeping problems might receive medication for that. … But the big goal is to lighten the therapy, or speed it up, with a PTSD-specific medication."

One other non-pharmacological treatment, of course, would be to fight fewer wars.

http://www.miller-mccune.com/health/class-of-antipsychotics-ineffective-in-treating-ptsd-34835/

Astrophile: The impossibly modern star

- 12:24 01 September 2011 by **Lisa Grossman**



'Impossible' star SDSS J102915+172927 lies in the Leo constellation (image ESO/A. Fujii/Digitized Sky Survey 2)

Object type: Star
Mass: 0.8 times the sun

Imagine you're an archaeologist. You find what looks like the skeleton of a protohuman. One hand seems to be grasping an object – could it be a clue to how these early beings lived? You scrape off the mud only to find that the object resembles a cellphone.

Your sense of shock is akin to how Lorenzo Monaco of the European Southern Observatory in Chile and colleagues must have felt when they examined the elemental composition of an oddball star, prosaically named SDSS J102915+172927.

The low concentration of chemical elements heavier than hydrogen and helium suggests it is the most primitive star ever discovered, yet the exact ratio of these heavier elements suggests it is much younger.

"In some sense it is a perfectly normal star, but it is different because it's in a very low metal range," Monaco says. The universe is so full of hydrogen and helium and empty of everything else that astronomers consider any element heavier than helium a metal.

Elemental factory

The relationship between a star's age and its elemental composition stems from the way the early universe evolved.

The first stars are thought to have condensed out of the hot soup left over from the big bang and contained only hydrogen, helium and a trace of lithium. They were giants tens of times more massive than the sun, and they quickly exploded as supernovas. But first they built up heavier elements in their cores, where intense pressure and heat allowed nuclear fusion reactions to occur. When these stars exploded, they spewed elements from carbon to iron, which subsequent generations of stars incorporated. The process occurred again and again, with younger generations acquiring larger fractions of heavier elements.

Astronomers expected that low-mass stars, about 0.8 times the mass of the sun or smaller, couldn't form from the same primordial stuff as these early giants. The clouds of gas would be too hot to squeeze apart into separate clumps. Instead, these smaller stars formed after several generations of supernovas, when the matter available would have contained enough carbon and oxygen for these elements to act as a coolant, allowing smaller stars to clump out of the gas. Eventually, this is how the sun formed.

Impossible star

Until now, the universe seemed to agree. Astronomers had found only three stars with very low amounts of heavier elements. They were low-mass, and oxygen and carbon dominated the traces of heavier elements they did have. This meant they passed the carbon-oxygen threshold needed to form a low-mass star – despite having a very low concentration of heavier elements overall.

Not so SDSS J102915+172927. When Monaco and colleagues used two spectrographs at the Very Large Telescope in Chile to examined its elemental composition, they found it had the lowest content of heavier elements ever seen yet – 4.5 millionths that of the sun. The star is almost entirely hydrogen and helium, making it look like one of the very first in the universe.

"This star has the composition that is the nearest that has been found up to now to the big bang composition," says Piercarlo Bonifacio of the Paris Observatory, France.

Yet, rather like modern stars, its oxygen and carbon levels do not dominate over the other heavier elements. This means there is not enough carbon and oxygen overall to meet the critical threshold needed to form a low-mass star. According to the theory, this star should not have been able to form.

Interstellar coolant

But it did. One explanation is that that the star is indeed near-primordial and that its nursery was cooled by something other than carbon and oxygen, like interstellar dust.

It's also possible that low-mass, low-metal stars like this one could be detritus from giant stars' birth, suggests Abraham Loeb of Harvard University, who first suggested that carbon and oxygen were required for forming low-mass stars but was not involved in the new study.

Some recent simulations have shown that giant stars form a disk of gas around them, and that disk can split up and scatter, like an out-of-control merry-go-round. Such a small star would not need the cooling effect of carbon and oxygen to clump into separate pieces. "It's quite possible that one could make low-mass stars out of pristine gas," he says.

Loeb is currently working on a book about how the first stars and galaxies form. In light of the recent work, he's considering adding in an amendment.

http://www.newscientist.com/article/dn20850-astrophile-the-impossibly-modern-star.html?full=true&print=true

What's wrong with our universities?

by James Piereson

On the ailing state of higher education.

Burke

was right!

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This fall more than 19 million students will enroll in the 4,000 or so degree-granting colleges and universities now operating in the United States. College enrollments have grown steadily year by year, more than doubling since 1970 and increasing by nearly one-third since the year 2000. More than 70 percent of high school graduates enroll in a community college, four-year residential college, or in one of the new online universities, though only about half of these students graduate within five years. The steady growth in enrollments is fed by the widespread belief (encouraged by college administrators) that a college degree is a requirement for entry into the world of middle-class employment. A college education is now deemed one of those prizes that, if good for a few, must therefore be good for everyone, even if no one in a position of academic authority can define what such an education is or should be. These conceptions are at the heart of the democratic revolution in higher education.

Higher education is thus a "growth" industry in America, one of the few that foreigners (now mostly Asians) are willing to support in large numbers. College tuition and expenses have increased at five times the rate of inflation over the past three decades, forcing parents and students deeply into debt to meet the escalating costs. Fed by a long bull market in stocks, college and university endowments have exploded since the mid-1980s, providing even more resources for salaries, new personnel, financial aid, and new buildings and programs. A handful of prestigious colleges and universities, mainly private, are overwhelmed each year by applications from high school seniors seeking to have their tickets punched for entry into the upper strata of American society. But these elite institutions are far from representative of higher education as a whole. The vast majority of colleges and universities—90 percent of them at least—admit any applicant with a high school diploma and the means to pay. Given the availability of financial aid, any high school graduate who wishes to attend college can do so.

Many universities, and not a few colleges, have come to resemble Fortune 500 companies with their layers of highly paid executives presiding over complex empires that contain semi-professional athletic programs, medical and business schools, and expensive research programs along with the traditional academic departments charged with providing instruction to undergraduate students. Like other industries, higher education has its own trade magazines and newspapers, influential lobbying groups in Washington, and paid advertising agents reminding the public of how important their enterprise is to the national welfare. In contrast to corporate businesses, whose members generally agree on their overall purpose, colleges and universities have great difficulty defining what their enterprise is for. What is a college education? On just about any campus, at any given time, one can find faculty members in intense debate about what a college education entails and what the mission of their institution should be. Few businesses would dare to offer a highly expensive product that they are incapable of defining for the inquiring consumer. Yet this is what colleges and universities have done at least since the 1960s, and they have done so with surprising success.

The most trenchant criticisms of these developments in higher education have come primarily from the conservative end of the political spectrum. From the time that William F. Buckley, Jr., published *God and*

Man at Yale in 1951, conservatives have been the main critics of the drift of college and universities away from their traditional role as guardians of civilization and into the political-corporate institutions that they have gradually come to resemble. Over the decades conservatives such as Russell Kirk, Allan Bloom, and Roger Kimball have criticized academic institutions for dismembering core curricula, offering trendy but intellectually worthless courses, surrendering to political correctness, and providing comfortable sinecures for faculty at the expense of hard-working students and their parents. Conservatives were always skeptical of the campaign to democratize higher education, arguing that it was bound to lead to lowered standards and loss of purpose. Events have confirmed their predictions, even if their diagnosis has done little to alter the path of the American university.

Liberals have been more reserved in their criticisms of higher education, no doubt because they (in contrast to conservatives) have been in charge of the enterprise over these many decades. To the extent that they have called for reform in higher education, it has usually been to urge colleges and universities to move more rapidly down the path on which they were already traveling—that is, in the direction of more diversity, greater access, more student choice in courses and curricula, more programs for special groups, and so on. Because they have operated inside the walls of academe, liberals (and leftists) have never had much difficulty in translating their proposals into academic policy.

Yet a curious thing is now happening in the ever-expanding commentary on higher education: many of the criticisms formerly made by conservatives are now being reprised by liberals, or at least by authors who are in no way associated with conservative ideas or organizations. At least two distinguished academic leaders, Anthony Kronman, the former Dean of the Yale Law School, and Harry Lewis, the former Dean of Students at Harvard, have published stern critiques of colleges and universities for failing to challenge students with the great moral and political questions that were once incorporated into liberal arts curricula. Now several books have appeared, written from a liberal point of view, that take colleges and universities to task on various counts: they are too expensive; the education they offer is sub-par, especially in relation to costs; they are administratively top-heavy; their faculties are too specialized; they do not emphasize teaching; their catalogs are filled with bizarre courses; and, more importantly, they are not providing the liberal arts education that students need and deserve. These are serious charges, especially when one considers who is making them. What lies behind them? And what do the authors propose to do about them?

The most comprehensive indictment is set forth in a new book by Andrew Hacker and Claudia Dreifus, titled *Higher Education: How Colleges Are Wasting Money and Failing Our Kids—and What We Can Do About It.*1 The authors cannot be accused of being outsiders to the industry or lacking in understanding of their subject. Hacker is a distinguished political scientist, the author of many academic books, formerly a professor at Cornell University, and now an emeritus professor at Queens College in New York City. Dreifus writes for the Science section of *The New York Times* and is a faculty member at Columbia University's School of International and Public Affairs. It is surprising—refreshing even—to encounter a wide-ranging critique of higher education set forth by authors with such impeccable credentials. Yet one would never call this a balanced or even-handed critique. It is meant to arouse indignation and to bring forth remedies for the ills it diagnoses. And, along the way, the book makes many useful points, generally documented by facts and illustrations.

Hacker and Dreifus begin from the premise that higher education has lost its internal compass and no longer fulfills its basic obligations to the rising generation of Americans. As they write, "A huge—and vital—sector of our society has become a colossus, taking on many roles, and doing none of them well." The central purpose of higher education is to offer an education that will turn students into "thoughtful and interesting human beings," the putative goal of an education in the liberal arts. Colleges and universities have weighed themselves down with so many ancillary activities, from technical research to varsity athletics, that they have lost sight of their basic mission.

The authors write from the standpoint of the older—or pre-1960s—liberalism that assumed that democratic education and the liberal arts should operate in tandem. Thus they assert that every student can learn, that a college education should be available to all, and that such an education should revolve around the liberal arts, loosely defined. Yet, in the 1960s, the claims of democracy and equality were perverted into the doctrine of diversity which held that the liberal arts have no truths to teach and that, therefore, colleges have no right to impose any curriculum on their faculty and students. The authors seem to think that this older synthesis can be resurrected on campus if only some institutional encrustations like disciplinary research, administrative bloat, and varsity athletics can be peeled away. Though they are undoubtedly wrong about this (the problems go much deeper), their book contains many valuable observations that demonstrate that something is rotten in the world of higher education.

Higher education incorporates a basic contradiction: students enroll to receive an education, but faculty members are paid and promoted according to disciplinary research that is unrelated to teaching. In the authors' view, in fact, "there is an inverse correlation between good teaching and academic research." A heavy emphasis on research obviously causes professors to shortchange teaching responsibilities and to view colleagues at other institutions as a more important audience for their work than their own students. It also encourages faculties to load up college catalogs with narrow and arcane courses as young professors "teach their dissertations" and veteran professors teach their latest research projects. In this way the research agenda in the various disciplines invades the undergraduate curriculum. The tenure system, originally created to protect the freedom of faculty to conduct research, now insulates professors from incentives to perform in the classroom. At the same time, tenure is no longer a necessary protection since there are now judicial and contractual remedies for any serious violations of academic freedom.

Moreover, since research professors must have graduate students, every major department must have its own Ph.D. program whether or not its graduates have any hope of finding jobs. The authors cite a telling statistic: between 2005 and 2007, American universities awarded 101,009 doctoral degrees but in those years created just 15,820 assistant professorships. Few graduate students have any realistic hope of pursuing careers in the fields in which they are being trained. Many of these redundant Ph.D.s wind up driving taxicabs or managing restaurants, but many are also recruited back to campus as adjuncts to teach courses for a fraction of what tenured professors are paid. The authors estimate that 70 percent of all college teaching is performed by adjuncts, graduate assistants, and other non-faculty personnel.

The proliferation of administrators—administrative bloat—is a major factor behind the escalating costs of higher education. The ratio of administrators per student has doubled over the past three decades. Across the country, there are now about 63 administrators per 1,000 students. At many of the prestigious colleges and universities, the ratios are far higher. At Williams College roughly 70 percent of the employees are occupied in other pursuits besides teaching. The additions have not included groundskeepers, janitors, and cafeteria workers, but positions like "babysitting coordinator," "spouse-partner employment counselor," and "queer-life coordinator" (a real position). This is a common pattern at highly ranked institutions. *The Chronicle of Higher Education* routinely runs advertisements for positions like Sustainability Director, Credential Specialist, and Vice President for Student Success. Wouldn't students be better served if, instead of filling positions like these, colleges and universities hired more philosophers, classicists, and physicists?

These superfluous administrators not only cost money (they have generous salaries), but they also invent work requiring still more of their kind, thus diverting institutional attention from learning and instruction to second and third order activities. A portion of administrative "bloat" is a function of the growing complexity of academic institutions, and some of it flows from governmental requirements. But in many cases the new administrators serve as advocates for special causes, demanding the hiring of more faculty and administrators in fields like feminism, environmentalism, and queer studies. In this sense, the expansion is an outgrowth of the politicization of the modern campus.

The most obvious expression of the administrative takeover of higher education is the emergence of "hired gun" presidents who move from institution to institution, generating higher salaries for themselves and their peers as they do so. The president of Ohio State University, who previously held top positions at Brown University, the University of Colorado, and West Virginia University, has a pay package exceeding $2 million. It is not uncommon today for college presidents to receive salary packages exceeding $1 million, courtesy of student tuition payments and taxpayer subsidies, while the average faculty member receives one-tenth of that. Are these men and women academic and intellectual leaders on their campuses, as college and university presidents (like Robert Maynard Hutchins and Charles William Eliot) were at one time? The answer in almost all cases is "no." They are hired mainly to raise money, manage complex bureaucracies, and keep their faculties happy. The emergence of this new kind of administrator reflects the overall loss of intellectual purpose in higher education.

Hacker and Dreifus reserve their strongest criticisms for a handful of elite institutions—the "Golden Dozen" as they call them—that set the tone (unjustifiably in their opinion) for higher education as a whole. The list is familiar: the eight Ivy League institutions, plus Duke, Stanford, Williams, and Amherst. They are the prestigious schools that all ambitious students hope to attend, even though only a small fraction of them can hope to win admission. The existence of this elite stratum of institutions seems to violate the authors' sense of democratic fairness. In their view, these schools are overrated and do not merit the hallowed reputations they have been assigned. They dutifully recognize several institutions of lesser rank (The University of Mississippi and Arizona State University, for example) that they believe do a better job of educating their students.

While all this may be true, the authors offer scant evidence for their conclusions. They do not try to assess the quality of education on offer (which would be a revealing exercise), but, in seeming contradiction with a major premise of their book, they try to assess how *successful* alumni bodies have been compared to the graduates of other institutions. They conclude on the basis of *Who's Who* entries that the alumni of the "Golden Dozen" do not fare any better in life than any other group of college graduates. Unfortunately, in using success as a measure, the authors buy into the idea that that what matters in an institution is not the quality of education it offers but, rather, the financial, social, and political achievements of its graduates. Using this criterion, they are unlikely to persuade ambitious students that they will be better off attending their local state university than matriculating to Harvard, Yale, or Stanford.

In the intellectual vacuum that has developed on campus, students understandably express vocational aspirations in their selection of courses and majors. Hacker and Dreifus are disappointed that so many students choose vocational majors, like business, engineering, and communications, over fields in the liberal arts like history, philosophy, and literature. Business is by far the leading major among undergraduates today, far surpassing the popularity of traditional fields in the humanities or social sciences. But who can blame the students for these choices, especially since they are no longer likely to hear anyone on campus making a good case for the liberal arts? If they are going to spend vast sums on a degree, then at least they want to be able to get a job when they graduate.

The authors set forth several controversial remedies to lower the costs of higher education and to return it to its central purposes. They would end tenure and sabbaticals for professors, emphasize teaching over research in all aspects of undergraduate education, curb the exploitation of adjunct professors, spin off university medical schools and research programs, eliminate varsity athletics, spread resources around to more institutions beyond the "Golden Dozen," reduce the costs of administration (especially presidential salaries), and exploit new technologies to improve classroom instruction. These are generally good ideas, though perhaps also utopian in current circumstances. Getting rid of varsity athletics, especially football, has long been a goal of academic reformers, and they are no nearer their goal today than they were fifty or one hundred years ago. Even so, some of these reforms, such as the elimination of tenure and the scaling back of varsity athletics, may come about in the coming years due to mounting financial pressures on colleges and universities. The fact that universities exploit adjunct teachers is a clear sign that they cannot afford to spread the costs associated with the tenure system across all instructional programs. As costs mount and available

resources dwindle, all institutions will be forced to confront basic questions about which programs they can afford to maintain. What advocacy and criticism cannot accomplish the laws of economics may eventually bring about.

The central weakness of Hacker and Dreifus's otherwise useful critique is that they never tell us what kind of education is most likely to produce "thoughtful and interesting human beings." What is an education in the liberal arts? What should students learn during their undergraduate years? Should every college have a core curriculum in the liberal arts, as most did a generation or two ago? The authors make a case for the liberal arts but fail to tell us what they entail or how they might be revived from their present condition.

The sad fact is that the liberal arts are dying on college campuses today due to the combined influences of specialization, diversity, and vocational goals. The century-long attempt to apply the scientific model to the humanities has at length produced the consequences that Hacker and Dreifus document so well. The various academic travesties that the authors cite are symptoms of a deeper problem. Many of these (such as the proliferation of pointless courses) take place in humanities departments and not in the sciences where a ladder of learning still exists and where research is linked to an ongoing search for knowledge. The fundamental problems of higher education, especially as they relate to its overall loss of purpose, can be traced back to the collapse of the liberal arts. In the process, there has opened up a large gulf between the sciences, where undergraduate teaching programs are generally very good (where resources are available) and the humanities, where teaching and research have lost their purpose and, with it, their value. Conservatives have known this for a long time. In reading *Higher Education*, one senses that there are now liberals who are beginning to feel their way toward the same conclusion.

In elementary and secondary education, costs have risen exponentially over recent decades even as student learning (as measured by achievement tests) has steadily declined. College costs have similarly risen several-fold since the 1970s, as Hacker and Dreifus demonstrate in great detail. Do we find a similar pattern in higher education, with escalating costs associated with losses in learning and academic rigor?

The answer to this question is "yes" according to two sociologists, Richard Arum and Josipa Roksa, who have set forth their case in a new book, *Academically Adrift: Limited Learning on College Campuses*.2 Arum, a professor at New York University, and Roksa, an assistant professor at the University of Virginia, claim on the basis of empirical data that college students are studying and writing less and learning far less than their peers of a generation ago, while our competitors abroad are passing us by in measures of achievement and rates of college graduation. America's competitiveness in the global economy is thus at risk thanks to declining standards in our colleges and universities.

The current movement to measure student learning was set in motion in 2006 by a report from the Spellings Commission (named for Margaret Spellings, then the U.S. Secretary of Education) which called for greater "transparency and accountability" in colleges and universities that receive federal aid. The report called for "better data about real performance" to allow students, parents, and policy-makers to compare institutions according to measurable outcomes. According to the Commission, such measures are needed in order to determine if "the national investment in higher education is paying off." The report was a signal that "outcomes testing," long used in elementary and secondary education, was about to be introduced into higher education as well.

In *Academically Adrift*, Arum and Roksa take up the challenge to measure student learning by drawing upon results from the College Learning Assessment (CIA), a standardized test given to more than 3,000 students at different institutions upon entry into college and then later at the end of their second and fourth years of undergraduate work. The cla asks students to examine a complex problem, such as an argument about crime reduction used in a political campaign, and then to write up their assessments of different approaches with their own recommendations. The test purports to measure critical thinking, complex reasoning, and ability to write both when students enter college and after two and four years of course work. Though burdened by the

social science excesses of data and methodology, *Academically Adrift* is a serious effort to find out if colleges and universities are delivering on their promise to educate all students. By its roundabout route, the book also yields several constructive recommendations as to how colleges and universities might be improved.

The authors report (predictably) that, during their college years, large numbers of students show little improvement in their abilities to reason, analyze, and write. According to their study, 45 percent of the sample showed little evidence of improvement after two years of college and 36 percent after four years. The performance gap between blacks and whites, already significant upon entry into college, widened further during the undergraduate years. As the authors conclude, "An astounding proportion of students are progressing through higher education today without measurable gains in general skills." Even so, nine in ten students say upon graduation that they are satisfied with their college experience.

The authors locate the sources of these disappointing outcomes in the culture of student life and in the lack of rigor in college curricula. Students spend the bulk of their time socializing with peers rather than studying. The culture of student life does not assign great value to learning and achievement. According to their study, students spend on average only about thirteen hours per week studying, far less time than students allocated to study in the 1960s. The reason that they can get away with it is that they encounter few courses that require much writing or significant amounts of reading, which does not come as a surprise given what we know about the current state of undergraduate courses.

Arum and Roksa agree with other authors about the basic problems of higher education. Colleges are bloated with administrators with impressive sounding titles, but none has a mandate to improve student learning. Adjunct and part-time faculty teach too many courses. Professors do not spend enough time in the classroom or meeting individually with students. College trustees and presidents are preoccupied with national rankings and reputations. Students are viewed as "consumers" and given too much choice in the selection of courses. Colleges devote too many resources to luxurious dormitories, student centers, and expensive athletic facilities in a misguided effort to entertain students and keep them happy. Interestingly enough, the authors call upon academic leaders to strengthen the general education requirements—that is, their core curricula—at their institutions to ensure that all students receive an education in the fundamentals.

The one conclusion that they do not reach is that too many students are attending college who are either not motivated or lack the skills to do college-level work. The Council for Aid to Higher Education reports that, "40 percent of students entering college do not read, write, or perform math at a college-ready level," a figure that closely approximates the numbers reported by Arum and Roksa that do not learn very much during their undergraduate years. Is it possible that we are sending 40 percent of our students to college unprepared for the experience and are unable to benefit from it? Are faculty and administrators "dumbing down" their curricula to make it possible for these students to pass the requirements? Reasonable observers have answered both questions in the affirmative, even if such answers seem to violate a national commitment to guarantee a college education to every student who wants one.

Academically Adrift has been widely criticized in academic circles because (it is said) the College Learning Assessments do not really measure learning but rather aptitude or something else unrelated to classroom instruction. While this is possibly so (the makers of the test dispute it), results from the CIA are undoubtedly closely correlated with those of the SAT and ACT examinations upon which administrators rely for admissions and which they claim are measures of learning rather than innate aptitude. If the cla does not do the job, then critics have an obligation to come up with a better test.

Of course, it is possible that no conceivable test can accurately measure what students should really learn during their college years. The purpose of higher education, after all, is not to train students in the basic skills of reasoning and writing but to take students who already have them and supplement their education with something more important—namely, knowledge and understanding. The campaign to turn colleges into glorified high schools has been as misguided as the effort to turn the humanities into a science. It is not

possible to educate students in something called "critical thinking" in the absence of a foundation of knowledge. Students who have taken the trouble to fortify themselves with knowledge will naturally develop the capacities both to criticize and to affirm, and to understand the difference between the two. An education in the liberal arts, rightly understood, is one means by which educators in the past sought to engage students in the search for knowledge and understanding. Whatever the weaknesses of that approach, academic leaders have yet to find an effective substitute for it.

Mark C. Taylor's *Crisis on Campus: A Bold Plan for Reforming Our Colleges and Universities* is an enlarged version of a 2009 op-ed article he published in *The New York Times*, in which he called for the abolition of the tenure system and the elimination of permanent academic departments that he sees as the obsolete equivalents of assembly lines and the small family farm.3 The title of that article, "End the University as We Know It," provides a sense of the ambitious—and inflated—aims of his proposals. In his view, the financial collapse has created a crisis on campus that will force academic leaders to re-organize their institutions if they are to survive in a time of dwindling resources.

Taylor, who is now the chair of the Religion department at Columbia University and previously was a longtime professor in the humanities at Williams College, decided to enlarge the essay into a book because of the popular response it provoked. He writes, "My analysis of the current state of higher education and proposals for change set off a firestorm of discussion and controversy." Well, perhaps—but he would have served the debate better by letting matters stand with the short statement of his position.

Taylor's book, unfortunately, reads like an extended opinion piece, long on assertions and proposals but short on analysis and supporting information. He sets forth many proposals, but few of them are new or bold. Like Hacker and Dreifus and many before them, he wants to end tenure, primarily to open up opportunities for young scholars who have worked for years to earn Ph.D.s only to find that there are no jobs when they are finished (though this was not exactly a secret when they began). Like other critics, he thinks that colleges and universities encourage disciplinary research at the expense of teaching. He urges a national collaboration between elite and non-elite institutions to train and reward good teachers, which is a good idea. He thinks that computers and video games should be used widely to improve the quality of teaching and break down barriers between disciplines, and goes so far as to suggest that colleges and universities should be restructured to reflect the open and adaptable characteristics of computer networks.

Taylor is especially keen to promote more cross-disciplinary activities that bring scholars from different fields—like art and physics or religion and international affairs—together to address new problems. There are many professors who resist such collaborations, preferring to focus on the subject matter in their disciplines. At the same time, this kind of inter- and cross-disciplinary work has been going on for a long time on major campuses where new combinations of fields are continually evolving into new disciplines like regional science, biochemistry, the history of science, social psychology, and neuroscience. But these fields evolve out of existing disciplines and do not emerge *de novo*, as Taylor would like them to do.

Taylor does have some ideas that are new and bold, but they are not necessarily constructive or practical. He advances a bizarre proposal to eliminate permanent departments and to reconstitute fields on the run to study particular subjects like water, time, money, law, and networks. After a few years when these fields have been adequately mined, they would be dissolved and new ones developed out of the passing interests of students and faculty. Graduate students could earn advanced degrees in any of these temporary fields, perhaps by producing films, video games, or new websites in place of the traditional written dissertation. A college or university could never organize its affairs in this manner without turning its professors into dilettantes and its students into reflections of the passing fashions of the hour. Taylor expresses little appreciation for the ways in which scientists conduct their affairs or how they establish new knowledge on the basis of painstaking and time-consuming research. It is good that some professors are given to flights of imagination, but it is also good that some have their feet planted firmly on the ground.

Nor is Taylor particularly sympathetic to the liberal arts as a discipline through which the lessons and achievements of the past are transmitted from generation to generation. He is an enthusiast for the new: new technologies, new ways of learning, and new and untested patterns academic organization. It is unusual to encounter a humanist and philosopher so thoroughly enthralled with the possibilities of computers and online networks, undoubtedly a sign that he does not know enough about them. Taylor's proposals would indeed "end the university as we know it." Would that be a good thing? The university is in real need of reform but not necessarily of upheaval—at least not yet.

Taylor is undoubtedly correct on one point: the financial crash and the long recession will undoubtedly put new pressures on colleges and universities to cut costs and eliminate superfluous programs and personnel. The "higher education bubble," as he calls it, is in the process of bursting, like the other "bubbles" of our era. The contemporary university is, to a great extent, the product of a postwar American affluence that is gradually coming to an end. Rising tuition, escalating salaries, administrative overload, and doubling and redoubling endowments are all reflections in one way or another of a steadily growing economy and an historic bull market in stocks (and the nation's ability to borrow unlimited sums). As resources become harder to find, as families can no longer afford current tuition prices, and as federal resources are withdrawn, college and university leaders will be hard pressed to maintain the gains of the past few decades. Many of the current excesses of higher education that developed out of affluence will unwind in the new era of austerity.

Yet were I asked to set forth a short list of preferred reforms in higher education based upon the information contained in these books, then I would emphasize the following:

(1) Shelve the utopian idea that every young person should attend college and also the notion that the nation's prosperity depends upon universal college attendance. Many youngsters are not prepared or motivated for college. Let them prepare for a vocation. The attempt to push them through college is weakening the enterprise for everyone else.

(2) Terminate most Ph.D. programs in the humanities and social sciences. There is little point in training able people in research programs when they have no prospect of gaining employment afterwards. The research enterprise has also corrupted all of these fields, particularly in the humanities.

(3) Develop programs in these fields that will allow students to earn graduate degrees based upon teaching rather than research. Such programs will be intellectually broad rather than specialized and will equip graduates to teach in several fields in the humanities. This will strengthen teaching in the liberal arts and perhaps even revive the field from its current condition.

(4) Reverse the expansion of administrative layers, especially those offices and programs created to satisfy campus pressure groups. If campus groups want their own administrative offices, they should pay for them themselves, rather than asking other students (and their parents) to do so. Colleges and universities should make it a practice to hire at least three new faculty members for every new administrator hired.

(5) Bring back general education requirements and core curricula to ensure that every student is exposed to the important ideas in the sciences and humanities that have shaped our civilization. There are many ways of doing this. Columbia University has always done it through a "great books" approach; other institutions do it through a series of survey courses in the sciences and liberal arts. How it is done matters less than that it is done.

Despite the liberal outlook of most professors, higher education is one of the most conservative of enterprises. Its patterns of organization have evolved gradually over the generations, and it is highly resistant to reform, particularly wholesale reform and reorganization. In recent decades, it has been marked more by dissolution than reform. One ought not to think that any of the recommendations advanced above or set forth in the books discussed here will be implemented any time soon. They represent just the start of a long-running

conversation. *Pace* Dr. Taylor, colleges and universities of the future are likely to look much as they do today, except that they will operate with fewer resources and much narrower margins for excess.

1 *Higher Education: How Colleges Are Wasting Our* M*oney and Failing Our Kids—and What We Can Do About It*, by Andrew Hacker & Claudia Dreifus; Henry Holt & Company, 271 pages, $26.

2 *Academically Adrift: Limited Learning on College* C*ampuses, by* Richard Arum and Josipa Roksa; University of Chicago Press, 259 pages, $70.

3 *Crisis on Campus: A Bold Plan for Reforming Our* C*olleges and Universities*, by Mark C. Taylor; Knopf, 256 pages, $24.

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http://www.newcriterion.com/articles.cfm/What-s-wrong-with-our-universities--7137

Fleet of hybrid airships to conquer Arctic

14:15 8 September 2011
Technology

Joel Shurkin, contributor

(Image: HAV)

Travelling through the Arctic is notoriously difficult and climate change is making it even harder. But there is a way to rise above the problem: the latest generation of lighter-than-air vehicles. Canadian company Discovery Air has signed a contract with the UK's Hybrid Air Vehicles (HAV) to buy around 45 new hybrid air vehicles. These aircraft will be used across Canada's Northwest Territories.

Whether taking out lumber from the forests or helping people access remote villages, transportation in Arctic Canada can be extrememly daunting. Most transportation is either by air, which is expensive, by boat, or by ice road. Rising winter temperatures, due to climate change, are likely to make Canada's ice roads less stable and reduce the amount of time in winter in which they can safely be used.

Gordon Taylor, marketing director for HAV, says the vessels are technically neither airships nor blimps. While they do make use of non-explosive helium for lift, they also get substantial lift from the aerodynamic design of the fuselage.

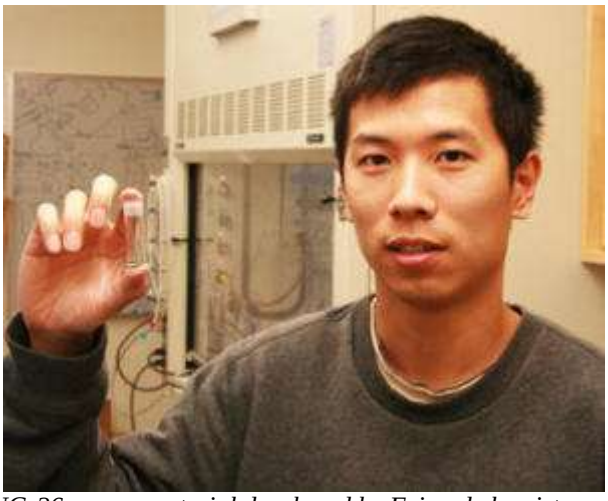
HAV already has a major contract for hybrid vehicles with the US Defence Department for long-endurance surveillance vessels.

The vessels Discovery Air has ordered are HAV's model 366, which Taylor says can carry 50 tonnes if they take off horizontally like an airplane and around 30 tonnes if they take off vertically. Not even the largest helicopters in the world can match that, explains Taylor.

One hundred and ten metres long, the vessels can reach altitudes of almost 3000 metres and can take off and land almost anywhere. The cargo will fit in the fuselage for very long trips or can hang beneath the ship for shorter ones. Later models can also be flown remotely.

http://www.newscientist.com/blogs/onepercent/2011/09/arctic-airships.html

New Material Shows Promise for Trapping Pollutants



Graduate student Honghan Fei holds a sample of SLUG-26, a new material developed by Fei and chemist Scott Oliver. (Credit: Photos by T. Stephens.)

ScienceDaily (Sep. 8, 2011) — Water softening techniques are very effective for removing minerals such as calcium and magnesium, which occur as positively-charged ions in "hard" water. But many heavy metals and other inorganic pollutants form negatively-charged ions in water, and existing water treatment processes to remove them are inefficient and expensive.

Chemists at the University of California, Santa Cruz, have now developed a new type of material that can soak up negatively-charged pollutants from water. The new material, which they call SLUG-26, could be used to treat polluted water through an ion exchange process similar to water softening. In a water softener, sodium ions weakly attached to a negatively-charged resin are exchanged for the hard-water minerals, which are held more tightly by the resin. SLUG-26 provides a positively-charged substrate that can exchange a nontoxic negative ion for the negatively-charged pollutants.

"Our goal for the past 12 years has been to make materials that can trap pollutants, and we finally got what we wanted. The data show that the exchange process works," said Scott Oliver, associate professor of chemistry at UC Santa Cruz.

The chemical name for SLUG-26 is copper hydroxide ethanedisulfonate. It has a layered structure of positively-charged two-dimensional sheets with a high capacity for holding onto negative ions. Oliver and UCSC graduate student Honghan Fei described the compound in a paper that will be published in the journal *Angewandte Chemie* and is currently available online.

The researchers are currently focusing on the use of SLUG-26 to trap the radioactive metal technetium, which is a major concern for long-term disposal of radioactive waste. Technetium is produced in nuclear reactors and has a long half-life of 212,000 years. It forms the negative ion pertechnetate in water and can leach out of solid waste, making groundwater contamination a serious concern.

"It's a problem because of its environmental mobility, so they need new ways to trap it," Oliver said.

In their initial studies, the researchers used manganese, which forms the negative ion permanganate, as a non-radioactive analog for technetium and pertechnetate. The next step will be to work with technetium and see if SLUG-26 performs as effectively as it did in the initial studies.

"Whether or not it can be used in the real world is still to be seen, but so far it looks very promising," Oliver said.

This research was supported by the National Science Foundation.

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The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of California - Santa Cruz**. The original article was written by Tim Stephens.

Journal Reference:

1. Honghan Fei, Scott R. J. Oliver. **Copper Hydroxide Ethanedisulfonate: A Cationic Inorganic Layered Material for High-Capacity Anion Exchange**. *Angewandte Chemie*, 2011; DOI: 10.1002/ange.201104200

http://www.sciencedaily.com/releases/2011/09/110906134011.htm

New forensics tool can expose all your online activity

- 07 September 2011 by **Jamie Condliffe**
- Magazine issue 2828.

IT IS another escalation in the computer security arms race. Software that can uncover all of a person's online activity could, in the hands of the police, put more sex offenders behind bars - but it may also be exploited to develop new ways of avoiding being caught.

Researchers from Stanford University in California have managed to bypass the encryption on a PC's hard drive to find out what websites a user has visited and whether they have any data stored in the cloud.

"Commercial forensic software concentrates on extracting files from a disc, but that's not super-helpful in understanding online activity," says Elie Bursztein, whose team developed the software. "We've built a tool that can reconstruct where the user has been online, and what identity they used." The open-source software, Offline Windows Analysis and Data Extraction (OWADE), was launched at the Black Hat 2011 security conference and works with PCs running on the Windows operating system.

The majority of sensitive data on a hard drive, including browsing history, site logins and passwords, uses an algorithm to generate an encryption key based on the standard Windows login.

Last year, Bursztein and his colleagues discovered how this system works - making them the only team in the world, other than Microsoft, able to decrypt the files. Now the team have made their discovery public, with free access.

The OWADE software combines this new knowledge with existing data-extraction techniques to create a single package that can uncover illegal online activities.

"Say you're working on a paedophilia case and you might want to know if people had interactions with minors on social networking sites," says Bursztein. Previously, with only access to a hard drive, the police would not be able to match suspects to online identities, let alone gain access to their accounts. "Now, law enforcement organisations can extract information from websites like Facebook to find out," he says.

However, those intent on remaining anonymous could exploit the system. "If somebody knows what they're doing with their data, they will try and hide it and work around [solutions like this] as much as they can," says John Haggerty from the University of Salford, UK.

http://www.newscientist.com/article/mg21128285.300-new-forensics-tool-can-expose-all-your-online-activity.html

Germany Crafts Its Nuclear Power Exit Strategy

Phasing out nuclear power around the world is easier said than done; the Germans (and Japanese) are, so far, the most serious about it.

By Michael Scott Moore

A nuclear power plant in Biblis, Germany. Germany, and Japan out of sheer despair, are the two countries seriously taking steps to phase out nuclear power generation. (Andy Rudorfer/Flickr.com)

One surprising development this summer is the international vogue for shutting down nuclear plants. Germany led the way in the spring — startling even its own industry leaders — after the disaster at Fukushima. Since then Switzerland, Italy, Taiwan, and Japan have either started serious debates or actively resolved to forego nuclear power in the next decade or two.

In Italy the decision was passive, in favor of a status quo: Voters turned out in June to reject Silvio Berlusconi's plan to revive an old nuclear program. But the sentiment, in every case, was driven by the Fukushima crisis, which still hasn't ended.

The developed world still needs nuclear power, at least for now. The German phase-out — which I'm in favor of — is highly experimental, and the ambition to end nuclear power by about 2022 would be impossible for Berlin to contemplate if many terawatts of current weren't being reliably produced by reactors in next-door France.

The plan will also set Germany back on its haunches: Its grid will have to rely more heavily on coal and natural gas until renewable energies are strong enough to run the planet's fourth-largest industrial nation. The

statistics look so daunting that it's hard to believe any country (besides Japan) would even discuss shutting down its nuclear plants. But Fukushima sent a powerful shudder through voters as well as politicians.

Chancellor Angela Merkel hopes that by 2022 Germany won't need French nuclear current *or* extra coal to meet demand. Her dream (she says) is to make Germany so energy-efficient and green that it becomes a model for everyone else. Her government wants Germans to demonstrate just how to move beyond old fuel sources, whether coal or atomic fission.

It probably won't work as planned. Even if Germans pull together to make their "energy revolution" real, they'll probably spend a great deal of money, miss their self-imposed deadlines, grumble about mounting energy prices and burn too much coal. That would be nothing new for Germany. The reason for optimism is that this phase-out plan — unlike an earlier plan — arrived with a kick in the pants to German industry.

The national rail service, Deutsche Bahn, is frantically searching for a way to run its trains on wind, hydroelectric and solar energy. Berlin passed its first nuclear phase-out law in 2001, but it's only since the earthquake and tsunami in Japan that Deutsche Bahn has been serious about mixing more renewable sources into its (enormous) daily load.

EUROPEAN DISPATCH
Michael Scott Moore complements his standing feature in Miller-McCune magazine with frequent posts on the policy challenges and solutions popping up on the other side of the pond.

"Since Fukushima, Deutsche Bahn has been moving in the right direction," Peter Ahmels, an energy expert at the German Environmental Aid Association, told Reuters. "There's clearly a new thinking on the board. They're doing sensible things. Before, they resisted. The argument was that renewables were not their core business."

Now the rail system wants to boost its share of renewable energy use from 20 percent today to 28 percent by 2014 — and wean itself from CO2-emitting fuels completely by 2050. "That's not just a declaration of intent," Hans-Jürgen Witschke, head of the energy-supply group Deutsche Bahn Energie, said to Reuters. "It's a concrete business target."

These efforts will repeat themselves throughout German industry if the country intends to move beyond nuclear power in a responsible way after 2022. Merkel has already promised a lot more money for energy research, since her goal may be impossible without a number of technological advances.

No doubt the results will be messier than the dream. No doubt Merkel wants to win votes in a nation notoriously opposed to nuclear power. But where else in the world do industry, government and the public look so mobilized? Japan, perhaps, out of horror. Not Taiwan. Certainly not Italy. The sensible Swiss have given themselves an extra dozen years of breathing room before their nuclear darkness — but then they might have to rely on the Germans for new technology since they don't have the same big research base.

America?

http://www.miller-mccune.com/environment/germany-crafts-its-nuclear-power-exit-strategy-35396/

WikiLeaks encryption row puts informants at risk

15:45 5 September 2011

Paul Marks, senior technology correspondent

It's a basic tenet of information security not to reveal your passwords - or how you generally construct them. So *The Guardian* newspaper's recently highlighted decision to publish a WikiLeaks password in a book on the cablegate affair has left infosecurity experts dumbfounded. Last week, the publication led to WikiLeaks hurriedly publishing, *unredacted*, all 251,000 of the US diplomatic cables it has in its possession - including the names of informants who have provided intelligence to US diplomats over many years.

While both sides have attempted to claim the moral high ground in their ongoing online spat, the affair has left both looking utterly untrustworthy to potential whistle-blowers - and future transparency will be the likely victim.

The *Guardian*/WikiLeaks argument began last November when their collaboration on the publishing of the first tranche of US diplomatic cables turned sour. In a subsequent book on the affair, the British newspaper's David Leigh took the rather odd decision to use a lengthy WikiLeaks passphrase as a chapter heading - presumably for dramatic effect - justifying the move on the grounds that he'd been told it was a temporary passphrase to the leaked cables that would soon expire.

WikiLeaks denies this was the case. It was not a changeable passphrase for something like a webserver, if I understand WikiLeaks' objections correctly. Rather than a password they could change, it was a file-specific Pretty Good Privacy (PGP) decryption key for a file containing all 251,000 of the unredacted state department cables. And as the key for a lone encrypted file it was not temporary - re-encrypting a cleartext copy would have been the only way to create another password/phrase.

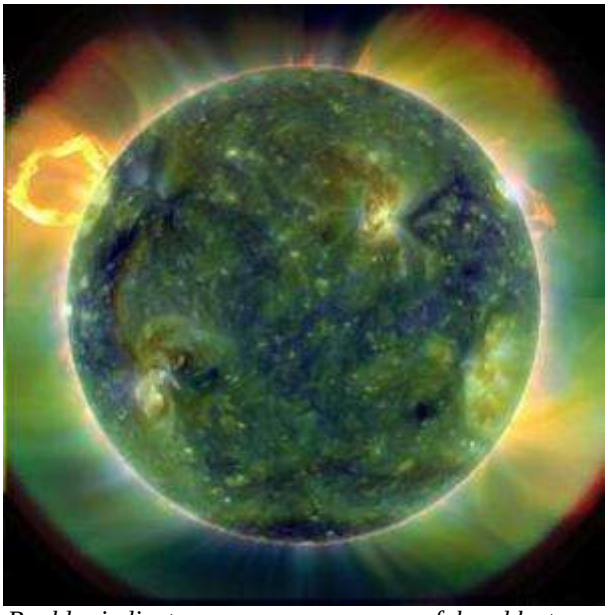
This week, somebody who tracked down or knew the hidden location of the PGPed cable file (which was distributed on BitTorrent sites) is said to have decrypted the leaked cables using *The Guardian*'s published passphrase and transmitted them to sites like Cryptome.org, a radical, no-holds-barred transparency website run by New York architect John Young, who's been posting leaked documents and pictures for a lot longer than Julian Assange and his crew - but without the media hoo-ha, which Young abhors.

Small subsets of the cables in the file tranche were meant to be under scrutiny by up to 50 media partners worldwide for informant redaction. But with the cat out of the bag, Assange on Friday decided to forget the redaction process and go public, dumping the whole tranche of 251,000 cables online sans redaction. "We're shining a light on 45 years of US 'diplomacy', it is time to open the archives forever," WikiLeaks tweeted. The move was welcomed by Young as a return to WikiLeaks's "courageous founding principles of full disclosure".

But the move will almost certainly put informants at risk and is, frankly, hard to fathom. Source protection has to go beyond the leaker to the informants providing the information. Worse for WikiLeaks, it certainly won't encourage future whistle-blowers to turn to them.Five major news outfits that have worked with WikiLeaks have condemned the unredacted data dump outright, while others see the move as petulant and a sign of the end of the organisation as a meaningful transparency force. So far WikiLeaks appears to have been lucky with the fate of informants - thanks to intelligent redaction alongside expert media partners - but it looks like it may have just become the architect of its own undoing.

http://www.newscientist.com/blogs/onepercent/2011/09/sparks-fly-over-cablgate-as-th.html

Space Instrument Observes New Characteristics of Solar Flares; Findings May Lead to Improved Space Weather Forecasting



A new assessment of solar flares by a team led by CU-Boulder indicates some are more powerful and last longer than scientists had previously thought, findings that have implications for mitigating damage by solar storms to navigation and communication systems on Earth. (Credit: Image courtesy of NASA/SDO/AIA)

ScienceDaily (Sep. 8, 2011) — NASA's Solar Dynamics Observatory, which is carrying a suite of instruments including a $32 million University of Colorado Boulder package, has provided scientists with new information that energy from some solar flares is stronger and lasts longer than previously thought.

Using SDO's Extreme ultraviolet Variability Experiment, or EVE instrument designed and built at CU-Boulder, scientists have observed that radiation from solar flares sometimes continues for up to five hours beyond the initial minutes of the main phase of a solar flare occurrence. The new data also show that the total energy from this extended phase of the solar flare peak sometimes has more energy than that of the initial event.

Solar flares are intense bursts of radiation coming from the release of magnetic energy associated with sunspots. Flares are our solar system's largest explosive events and are seen as bright areas on the sun. Their energy can reach Earth's atmosphere and affect operations of Earth-orbiting communication and navigation satellites.

"If we can get these new results into space weather prediction models, we should be able to more reliably forecast solar events and their effects on our communication and navigation systems on Earth," said CU-Boulder Senior Research Associate Tom Woods of the Laboratory for Atmospheric and Space Physics, who led the development of EVE. "It will take some time and effort, but it is important."

"Previous observations considered a few seconds or minutes to be the normal part of the flare process," said Lika Guhathakurta, lead program scientist for NASA's Living With a Star Program. "This new data will increase our understanding of flare physics and the consequences in near-Earth space where many scientific and commercial satellites reside."

On Nov. 3, 2010, a solar flare was observed by SDO. If scientists had only measured the effects of the solar flare as it initially happened, the information would have resulted in underestimating the amount of energy shooting into Earth's atmosphere by 70 percent. The new capability with SDO observations will provide a much more accurate estimation of the total energy input into Earth's environment.

"For decades, our standard for flares has been to watch the X-rays as they happen and see when they peak," said Woods, the principal author on a paper appearing in online in the *Astrophysical Journal*. "That's our definition for when a flare goes off. But we were seeing peaks that didn't correspond to the X-rays."

Over the course of a year, the team used the EVE instrument to record graphs that map out each wavelength of light as it gets stronger, peaks and diminishes over time. EVE records data every 10 seconds, and thus EVE has observed numerous flares. Previous instruments only measured every hour and a half or didn't look at all the wavelengths simultaneously as SDO can.

"We are seeing something that is new and surprising about the physics of solar flares," said CU-Boulder doctoral student and paper co-author Rachel Hock. "When we looked at the observations from our instruments aboard SDO and compared them with our physical models, the results were consistent with each other," said Hoch of the astrophysical and planetary sciences department. "That was good news to us."

Because this previously unrealized extra source of energy from the flare is equally important in its impact on Earth's atmosphere, Woods and his colleagues are now studying how the late phase flares can influence space weather. In addition to impacting communication and navigation systems, strong solar flares can influence satellite drag and the decay of orbital debris.

When the ionosphere of Earth is disturbed by solar flares and coronal mass ejections, the communication between Earth-based instruments and GPS satellites can degrade, said Woods. "If GPS positions on Earth are off by 100 feet or so because of disruption in the ionosphere, it wouldn't be a big deal for someone driving down a highway," he said. "But if a farmer is using GPS to help determine precisely where to plant particular seeds, that GPS signal error could make a big difference."

To complement the EVE graphical data, scientists used images from another SDO instrument called the Advanced Imaging Assembly, or AIA, built by Lockheed Martin Solar and Astrophysics Laboratory in Palo Alto, Calif. Analysis of the images showed the main phase flare eruption and the secondary phase as exhibited by coronal loops or magnetic field lines far above the original flare site. These extra loops were longer and became brighter later than the original set and these loops were also physically set apart from those earlier ones.

SDO was launched on Feb. 11, 2010, and is the most advanced spacecraft ever designed to study the sun and its dynamic behavior. The advanced spacecraft provides images with clarity 10 times better than high-definition television and provides more comprehensive science data faster than any solar observing spacecraft in history.

EVE includes three spectrographs -- two built at CU-Boulder's LASP -- to measure the solar extreme ultraviolet radiation. By making measurements every 10 seconds at 10 times the resolution of previous instruments, EVE is providing scientists and space weather forecasters with the information to provide more accurate, real-time warnings of communications and navigation outages. "We can look at data every minute, 24 hours a day, to help us forecast what the sun is doing," said Woods.

LASP has a long history of making solar measurements dating back to the 1940s, even before NASA was formed, said Woods. LASP projects have ranged from designing, building and flying NASA's Solar Mesospheric Explorer Satellite, which measured the sun's effect on ozone production and destruction of

ozone in the 1980s, to the Solar Radiation and Climate Experiment, a $100 million NASA satellite designed, built and now being controlled by LASP to measure the effects of solar radiation on Earth's climate.

"We have a great tradition of working with students in all phases of our programs, starting with helping to design the instruments, helping to calibrate and test them as well as helping to operate them," said Woods. "Our primary focus is getting science results, and our students are helping with the data analysis for the EVE experiment."

NASA's Goddard Space Flight Center in Greenbelt, Md., built, operates and manages the SDO spacecraft for NASA's Science Mission Directorate in Washington, D.C. SDO is the first mission of NASA's Living with a Star Program, or LWS. The goal of LWS is to develop the scientific understanding necessary to address those aspects of the connected sun-Earth system that directly affect our lives and society.

For more information and images visit http://www.nasa.gov/sunearth. For more information about the SDO mission and instruments visit http://www.nasa.gov/sdo.

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Story Source:

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

Journal Reference:

1. Thomas N. Woods, Rachel Hock, Frank Eparvier, Andrew R. Jones, Phillip C. Chamberlin, James A. Klimchuk, Leonid Didkovsky, Darrell Judge, John Mariska, Harry Warren, Carolus J. Schrijver, David F. Webb, Scott Bailey and W. Kent Tobiska. **New Solar Extreme-ultraviolet Irradiance Observations during Flares**. *Astrophysical Journal*, 2011; DOI: 10.1088/0004-637X/739/2/59

http://www.sciencedaily.com/releases/2011/09/110907163909.htm

Black gold holds a charge for green cars

- 08 August 2011 by **Ferris Jabr**
- Magazine issue 2824.

It packs a lot more juice (Image: Dominick Reuter)

THE tiny glass bottle in my hand is filled with what looks like crude oil, but it's actually oil's nemesis. If it works, this black sludge will transform the rechargeable battery, doubling the range of electric cars and making petroleum obsolete.

Today's electric cars are handicapped by batteries that are heavy, expensive and a waste of space. Two-thirds of the volume of the battery in Nissan's Leaf electric car, for example, consists of materials that provide structural support but generate no power. And those materials cost more than the electrically active components.

One way to vastly improve rechargeable batteries is to put more of that deadweight to work. That's the purpose of the secret sauce in the bottle, nicknamed "Cambridge crude" by Yet-Ming Chiang and his colleagues at the Massachusetts Institute of Technology, who developed it.

In a standard battery, ions shuttle from one solid electrode to the other through a liquid or powder electrolyte. This in turn forces electrons to flow in an external wire linking the electrodes, creating a current. In Chiang's battery, the electrodes take the form of tiny particles of a lithium compound mixed with liquid electrolyte to make a slurry. The battery uses two streams of slurry, one positively charged and the other negatively charged. Both are pumped across aluminium and copper current collectors with a permeable membrane in

between. As they flow the streams exchange lithium ions across the membrane, causing a current to flow externally. To recharge the battery, you apply a voltage to push the ions back across the membrane.

The MIT creation is a type of flow battery, which normally has a liquid electrolyte that moves past stationary electrodes. Chiang reckons that the power per unit volume delivered by his lithium "semi-solid" flow battery will be 10 times that of conventional designs (*Advanced Energy Materials*, DOI: 10.1002/aenm.201100152).

"This is probably the most exciting development in electrical energy storage in the past couple of years," says Yury Gogotsi of Drexel Nanotechnology Institute in Philadelphia, Pennsylvania. "Chiang offers a unique hybrid between a flow battery and a lithium-ion battery."

Drivers could have three ways of recharging the semi-solid flow battery. They could pump out spent slurry and pump in fresh; head to a recharge station where tanks of spent slurry would be replaced with fresh ones; or recharge the slurries with an electric current. In the first two cases regaining full power should only take a matter of minutes.

Rechargeable batteries are the heaviest and most expensive components of electric cars by a large margin. Chiang estimates that the cost of manufacturing his team's battery will be $250 per kilowatt-hour of generating capacity. So if one were built to replace the 24-kWh battery in the Nissan Leaf, it would cost $6000. That is about one-third the cost of existing batteries, and just low enough to compete with gasoline. Chiang also calculates that Cambridge crude would let a car travel at least 300 kilometres on a single charge, double what is possible with today's batteries.

"This is an especially beautiful technology," says Dan Steingart of the City University of New York Energy Institute, because you can recharge the spent slurry. But he adds that even if the team manages to create a prototype car battery within five years, building the recharge stations to support it would take much longer.

Last year Chiang, his colleague Craig Carter and entrepreneur Throop Wilder founded a company called 24M Technologies to develop the battery. They have raised $16 million in funding so far, and plan to have a compact prototype ready in 2013.

http://www.newscientist.com/article/mg21128246.500-black-gold-holds-a-charge-for-green-cars.html

Jumping Gene's Preferred Targets May Influence Genome Evolution

Fruit fly (Drosophila melanogaster). (Credit: © Studiotouch / Fotolia)

ScienceDaily (Sep. 8, 2011) — The human genome shares several peculiarities with the DNA of just about every other plant and animal. Our genetic blueprint contains numerous entities known as transposons, or "jumping genes," which have the ability to move from place to place on the chromosomes within a cell.

An astounding 50% of human DNA comprises both active transposon elements and the decaying remains of former transposons that were active thousands to millions of years ago before becoming damaged and immobile. If all of this mobile and formerly mobile DNA were not mysterious enough, every time a plant, animal or human cell prepares to divide, the chromosome regions richest in transposon-derived sequences, even elements long deceased, are among the last to duplicate. The reason for their delayed duplication, if there is one, has eluded biologists for more than 50 years.

New research led by Carnegie's Allan Spradling and published online this week by *Proceedings of the National Academy of Sciences* provides potential insight into both these enigmas.

The scientists used the fruit fly, *Drosophila melanogaster*, one of the premier "model" organisms for studying genome structure and gene function. They focused on one particular transposon, called the P element, which has an unsurpassed ability to move that has stimulated its widespread use by *Drosophila* researchers.

Remarkably, P elements have only been present in *Drosophila melanogaster* for about 80 years, at which time they were acquired from the genome of a distantly related fruit fly species by an unknown process. P elements remain highly "infective" today. Adding just one copy to the genome of one fly causes all the flies in a laboratory population with which it breeds to acquire 30 to 50 P elements within a few generations. The original goal of the Spradling team's research was not to understand how transposons spread or genomes evolve, but something much simpler: To learn why P elements insert at some locations in the genome but not in others.

Spradling and his colleagues, who oversee the NIH-funded *Drosophila* "Gene Disruption Project" used a database containing more than 50,000 genomic sites where P elements have inserted. They built this exceptional database over the last 20 years.

P elements insert into DNA very selectively. Nearly 40% of new jumps occur within just 300 genes and always near the beginning of the gene. But the genes seemed to have nothing in common. When these sites were compared to data about the *Drosophila* genome, particularly recent studies of *Drosophila* genome

duplication, the answer became clear. What many P insertion sites share in common is an ability to function as starting sites or "origins" for DNA duplication. This association between P elements and the machinery of genome duplication suggested that they can coordinate their movement with DNA replication.

Spradling and his team propose that P elements -- and likely other transposons as well -- use a replication connection to spread more rapidly through genomes. These elements would only transpose after replicating, and then preferentially insert themselves into portions of DNA that have not yet become activated. This would allow them to duplicate twice rather than just once during the genome duplication cycle.

If the elements get a late start, however, only the last segments of the chromosome to duplicate will be left for their second duplication. This explains tendency of such regions to be transposon-rich. However, the researchers found that two other *Drosophila* transposons, known as piggyBac and Minos, do not insert at replication origins, so this mechanism is far from universal. Furthermore, Spradling cautioned that it is particularly difficult to experimentally test hypotheses about evolution.

"By gaining insight into one specific transposon's movements, we may have begun to glimpse mechanisms that have profoundly influenced genome evolution for nearly all animals" Spradling commented.

Spradling's co-authors on the paper are Hugo Bellen of Baylor College of Medicine and Roger Hoskins of Lawrence Berkeley National Laboratory.

Funding for this research was provided in part by the National Institutes of Health.

Story Source:

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

Journal Reference:

1. A. C. Spradling, H. J. Bellen, R. A. Hoskins. **Drosophila P elements preferentially transpose to replication origins**. *Proceedings of the National Academy of Sciences*, 2011; DOI: 10.1073/pnas.1112960108

http://www.sciencedaily.com/releases/2011/09/110906161634.htm

Virus gene engineer sends caterpillars to a sticky end

- 19:00 08 September 2011 by **Ferris Jabr**

Must climb… must climb… (Image: George Grall/Getty)

1 more image

It takes just one gene to rule them all. With that gene, a voodoo virus compels its caterpillar hosts to emerge from their shady hideaways, climb en masse to the tops of trees, deliquesce and fall as a rosy rain of viral particles on their fellow healthy caterpillars. Soon, they too will make the climb of doom.

The virus is known as baculovirus and its unsuspecting host the gypsy moth caterpillar. Like many other mind-controlling viruses, fungi and bacteria that, for instance, turn ants into zombies and make rats unusually fond of cats, baculovirus can selfishly change the behaviour of its host.

These bizarre relationships have long been documented but are poorly explained: suspicions that many of the behavioural changes reflect changes in gene expression have rarely led to genetic culprits.

Now researchers have found that the baculovirus uses a single gene to force gypsy moth caterpillars to meet their sticky treetop end and infect their relatives below.

Zombies by day

During the day, healthy gypsy moth caterpillars hide from birds and other predators by staying near the soil, sticking to the underside of branches or wedging themselves into crevices in tree trunks. Under the cloak of night, they come out to feed.

In contrast, caterpillars that are infected with baculovirus climb up to treetops in broad daylight, where they die because the virus has commanded every cell in their body to make copies of itself.

As if that wasn't bad enough, the virus also produces enzymes that break down the caterpillar's cell walls, liquefying it (see picture) into oozing pink puddles that swim with new viruses. The next time it rains, drops of water pelt the puddles and carry viruses down the tree, where they infect other caterpillars.

No more moulting

Kelli Hoover of Pennsylvania State University in University Park and her colleagues suspected that the baculovirus uses a gene called *egt* to change caterpillars' climbing behaviour. *Egt* codes for an enzyme that inactivates an insect moulting hormone called 20-hydroxyecdysone. This is useful because when caterpillars moult, they hunker down and largely stop feeding – so are much less likely to climb trees, foiling the baculovirus's plans.

Hoover infected gypsy moth caterpillars with six different strains of baculovirus: two of the viruses were unmodified, two were missing *egt* and two had had the gene removed and reinserted. Hoover placed the caterpillars in tall plastic soda bottles with food at the bottom and a fibreglass screen that the caterpillars could climb to reach the top.

Caterpillars infected with the normal baculovirus and the baculovirus with the returned *egt* gene died at the top of the bottles, in the manner typical of treetop disease. Caterpillars infected with the baculovirus missing the gene did not demonstrate unusual climbing behaviour.

Vince D'Amico, an entomologist with the US Department of Agriculture Forest Service, says the work is a first and key to advancing understanding of how baculovirus is transmitted through gypsy moths.

Genetic weapon

Exactly how *egt* forces caterpillars to climb to the tops of trees is not clear, but Hoover has some ideas. She notes that infected caterpillars initially act like healthy ones: they only sprint to the treetops about 24 to 36 hours before the virus overwhelms all the cells in their body.

She thinks that once the virus has inserted its genes into the caterpillar's cells, the enzyme for which *egt* codes gradually increases the amount of inactivated moulting hormone in the caterpillar's body – and that this build-up somehow triggers the unusual climbing behaviour.

In future, forest ecologists may be able to tweak baculovirus's genes to control the gypsy moth, which is an invasive species in North America and a major pest of hardwood trees, defoliating vast swathes of forest. Researchers have tested baculoviruses as biopesticides in the past, but found it worked too slowly compared with other pesticides. Genetically modifying the virus – perhaps by duplicating *egt* – could turn it into the gypsy moth's worst nightmare.

Journal reference: *Science*, DOI: 10.1126/science.1209199

http://www.newscientist.com/article/dn20886-virus-gene-engineer-sends-caterpillars-to-a-sticky-end.html

Clouds Don't Cause Climate Change, Study Shows

Clouds only amplify climate change, says a Texas A&M University professor in a study that rebuts recent claims that clouds are actually the root cause of climate change. (Credit: © Sergey Tokarev / Fotolia)

ScienceDaily (Sep. 8, 2011) — Clouds only amplify climate change, says a Texas A&M University professor in a study that rebuts recent claims that clouds are actually the root cause of climate change.

Andrew Dessler, a Texas A&M atmospheric sciences professor considered one of the nation's experts on climate variations, says decades of data support the mainstream and long-held view that clouds are primarily acting as a so-called "feedback" that amplifies warming from human activity. His work is published in the American Geophysical Union's peer-reviewed journal *Geophysical Research Letters*.

Dessler studied El Niño and La Niña cycles over the past 10 years and calculated Earth's "energy budget" over this time. El Nino and La Nina are cyclical events, roughly every five years, when waters in the central Pacific Ocean tend to get warmer or colder. These changes have a huge impact on much of the world's weather systems for months or even years.

Dessler found that clouds played a very small role in initiating these climate variations -- in agreement, he says, with mainstream climate science and in direct opposition to some previous claims.

"The bottom line is that clouds have not replaced humans as the cause of the recent warming the Earth is experiencing," Dessler says.

Texas is currently in one of the worst droughts in the state's history, and most scientists believe it is a direct result of La Niña conditions that have lingered in the Pacific Ocean for many months.

Dessler adds, "Over a century, however, clouds can indeed play an important role amplifying climate change."

"I hope my analysis puts an end to this claim that clouds are causing climate change," he adds.

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Story Source:

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

Journal Reference:

1. Andrew E. Dessler. **Cloud variations and the Earth's energy budget**. *Geophysical Research Letters*, 2011; DOI: 10.1029/2011GL049236

http://www.sciencedaily.com/releases/2011/09/110906121951.htm

Near-death experiences may be triggered by serotonin

- 08 September 2011
- Magazine issue 2829

THE bright light at the end of the tunnel which some people close to death describe may result from a flood of serotonin in the brain.

Near-death experiences (NDEs) are reported by around 1 in 5 critically ill people, and their cause is a mystery. Alexander Wutzler's team at the Charité University of Medicine in Berlin, Germany, wondered if serotonin - a neurotransmitter involved in mood regulation and processing vision and sound - plays a role.

They gave six rats an overdose of anaesthetic and found that serotonin levels in their brains had tripled by the time they died (*Neuroscience Letters*, DOI: 10.1016/j.neulet.2011.04.051).

Wutzler expects to see a similar increase in dying human brains. He says serotonin could be behind NDEs, but Jakob Hohwy at Monash University in Melbourne is unsure. "One thing that you don't want to say is that rats have NDEs," he says.

http://www.newscientist.com/article/mg21128294.900-neardeath-experiences-may-be-triggered-by-serotonin.html?full=true&print=true

Last Charge of the (Incandescent) Light Brigade

The movement to change your incandescent light bulbs for compact fluorescents completed its successful European Union campaign. The United States is next.

By Michael Scott Moore

The U.S. is next up on the campaign trail to encourage Americans to swap their incandescent bulbs for compact fluorescents. The switch required an attitude adjustment for European users, but ultimately, the campaign was successful. (Creatas)

Over the weekend, like a lot of people in Europe, I stocked up on light bulbs. The European Union has been phasing out old-fashioned incandescent bulbs for a couple of years, and on Sept. 1 a ban on 60-watt bulbs — the most popular kind — came into effect.

Now, no nation in the EU manufactures the filament style of bulb, the kind Edison patented in 1878, at least not at 60-watt strength. (Weaker incandescents will be produced until next year.) It's legal to sell off stock, but the plan is to cut carbon emissions by compelling Europeans to buy more durable, less wasteful, but initially more expensive sources of light.

"What you have to remember is, [the new bulbs] are going to deliver enormous energy savings," Mike Simpson, a technical director at Phillips UK, told the BBC last month. "Although they'll cost a little bit more in the shops, customers will get that money back many times over in the energy they're saving."

That sounded good to me. Last year — thinking ahead — I replaced two of the most important 60-watt bulbs in my apartment with compact fluorescent lamps, or CFLs. The price difference was shocking. Instead of 80 euro cents (about a dollar), the new bulbs cost €4 euro each (about $5.65). That was five times the price, but they're meant to last eight to 15 times as long.

The light was milky and pale. Fine — I had lampshades to change the color. Promises on the box for "equivalent light" were wrong, but I'd bought more powerful bulbs just in case, and I was still saving energy.

A new CFL that draws 11 watts is meant to shine as bright as a 60-watt incandescent; I bought 18-watt fluorescents and have a brighter room.

EUROPEAN DISPATCH
Michael Scott Moore complements his standing feature in Miller-McCune magazine with frequent posts on the policy challenges and solutions popping up on the other side of the pond.

Nothing but a law could have compelled me to think so long and hard about light bulbs. But now I had to agree that incandescent bulbs were nothing but "small heaters that produce a little light," and I could see how a law might spur the market toward more sensible bulbs. For months I felt clever and satisfied that I was doing my part to save energy in Europe.

Then one of the bulbs burned out.

Just like that, it quit. My filament bulbs tend to last a year or more, but one CFL gave up the ghost after maybe six months.

I was bitter. I'd taught myself to think in terms of long-term energy savings, so the sheer waste of money and material disgusted me. I went out to buy more incandescent bulbs. Then I tried to throw the CFL away, but something on the packaging suggested it wasn't normal trash. A CFL has to be carefully recycled; it contains mercury. Breaking the glass would release mercury vapor.

Well, breaking a thermometer releases mercury, too. But light bulbs tend to break more often, and the U.S. Environmental Protection Agency has detailed instructions for cleaning up a broken CFL: "Have people and pets leave the room. Air out the room for 5-10 minutes by opening a window or door to the outdoor environment. …"

These problems wouldn't matter much to Americans — let Europeans suffer with their silly laws — if a similar phase-out weren't coming to America next year. Starting in 2012, the U.S. will phase out 100-watt bulbs, according to an energy-savings bill passed in 2007 (under President George W. Bush). A handful of Republicans tried to roll back the law last month, without success, but it's bound to return now and then as a zombie topic on talk shows.

The law should stay, because it's already pushing markets to innovate — mercury-free bulbs are now on sale in the U.S. "They'd have carried on making this [incandescent] light bulb for another 120 years if they'd been allowed to," said Matt Prescott, who runs a British movement called Ban the Bulb, during the same BBC show that featured Simpson. "But society as a whole pays a large price, through having to build new power stations."

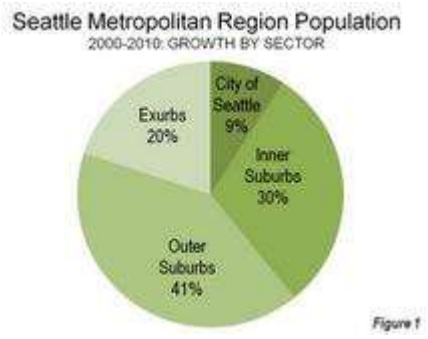
Maybe so. But there's nothing wrong with stocking up on incandescents.

They're a simple household bridge technology, until the industry for modern bulbs matures.

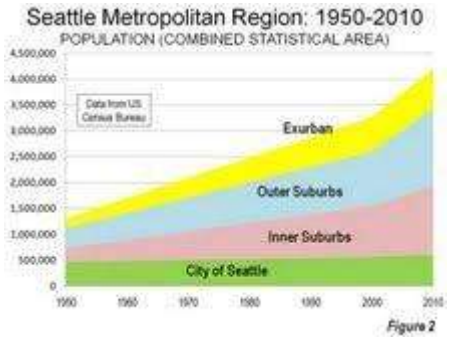
http://www.miller-mccune.com/environment/last-charge-of-the-incandescent-light-brigade-35821/

Urbanism needs to move beyond city boundaries

Our fractured metropolitan regions are the big problem in creating sustainable solutions for climate challenges. High-towered, dense city living is only a small part of the solution, which is to develop "ecological urbanisms."



Suburbs get the biggest slice of the pie.



Seattle will only capture a small share of growth.

By Peter Steinbrueck

Editor's Note: The following is adapted from a speech delivered last week to the American Political Science Association, which held its annual meeting in Seattle.

Urbanization is an unstoppable world megatrend. Over the past 60 years, the urbanized areas of the planet have gone from 29 percent in 1950, to half of the world's population today, and by 2050, 70 percent of the world's population is expected to live in urban regions.

Scientists describe the large communities of plants and animals that occupy distinct climatic regions on earth as "biomes." We should think of cities — and by my definition I mean whole networked urban regions — as the newest, rapidly expanding biomes of the earth.

Cities are already responsible for 70 to 80 percent of the world's energy consumption. Accordingly, climate change cannot be addressed without their transformation through strategic alliances. I'd like to suggest some ways to get on with this project.

A central, compelling question raised by political scientists, economists, planners, and other researchers is that, if cities are the fastest growing systems on earth — and causing resource depletion, species die-off, and declining natural ecosystems of unprecedented scale — how can we manage the way that urbanization is drastically restructuring the ecology of our planet?

Let's start with the United States, already one of the most highly urbanized countries in the world. By 2050 America is expected to grow by 120 million more people, and it is estimated that an 90 percent of Americans will live in cities and metro areas. Most will be located in a handful of vast mega-metro urban regions that cross state and even national boundaries. The growth of these metro regions, some 360 in all, is largely unbounded, not contained in any one political jurisdiction, and unmanaged.

Urbanist and philosopher Lewis Mumford in his prescient 1956 paper, "The Natural History of Urbanization," wrote that "the blind forces of urbanization, flowing along the lines of least resistance, show no aptitude for creating an urban and industrial pattern that will be stable, self-sustaining, and self-renewing."

One reason for these "blind forces" is the pattern of local politics in the United States over the past half century, which has served to amplify the urban–suburban divide rather bridge it. This has impeded the healthy and efficient growth of urban metros.

Yet most urbanists today see cities (meaning metropolitan regions) increasingly as hubs for innovation, places to experience urban vitality, and an answer to our global economic woes. Cities have an inherent urban advantage and the capacity for progressive and transformative change.

As Bruce Katz with Brookings Institution says, our U.S. metro regional economies are what will make the U.S. competitive again with other developing nations *if we can garner our interdependencies*, link up, and foster economic synergies among metro regions. In fact 82 percent of U.S. gross domestic product is produced in its metro regions.

According to economist Jeb Brugmann, author of *Welcome to the Urban Revolution,* urban scholars who have analyzed market flows have "discovered that global networks were patterned according to networks of cities." They have concluded that "the growing commerce between cities has created hierarchies between cities that define the new economic order. Cities and their networked systems — not countries or individual corporations — are the main command and control centers of a new world City system."

Brugmann continues: "The primary ecological challenge of the next decades… will be our ability to develop ecological urbanisms, …and [determining] whether the City evolves into a truly functional new ecosystem — a citysystem with stable if not synergistic relationships with natural systems."

Vancouver, B.C.: effective urban concentration.

Harvard Economics professor Ed Glaeser, in his recent acclaimed book, *Triumph of the City*, espouses a different view of environmental policy through city-building. "If you love nature, stay out of it," he declares. Build up, and up and up. Greater density is the goal, and the way to save the planet, he says.

But this is wrong-headed and simplistic. How will towers and more concrete save the planet, when they simultaneously increase human consumption, energy, and enlarging the ecological footprint of cities well beyond their borders? Furthermore, humans cannot separate themselves from nature, survive, and remain healthy. Nor do they want to.

The global challenge of urbanization in the 21st century will not be solved by concentrating people and separating them from nature. Theat creates what Brugmann calls "a parasitic system that disrputs the metabolism of Earth's great green, blue, tan, and white biomes, triggering chaotic ecological collapse."

Urban forms and zones are neither uniform nor fixed. They can be designed to mimic nature's efficiencies and productivities. So can buildings that attempt to use nature's free services in a clean, regenerative way. Whole cities can do the same. And, as we've just seen again with the hurricane Irene in the Northeast, another big worry is disaster readiness and resilience. In addition to some of these demographic changes, cities are going to have to get used to responding to more frequent disasters whether from earthquakes, tsunamis, flash floods, bush fires and other severe weather catastrophes related to climate change.

Yet by and large, cities in the U.S. are often handcuffed by state governments through restrictions at every level on land use, regulation, and revenue raising. Outside of major cities, the metro regions — where most people live in North America — fare even worse when it comes to reach of regulatory authority and revenue collection. Very few full service metro or regional governments with any land use control even exist in the U.S. (the exceptions are Portland, Miami Dade County, San Francisco, and Minneapolis).

For the Western Washington region, home to hundreds of local governments, the jurisdictional boundaries have very little to do with how we live and even where we work, and shop. This is true for most other metro regions in the country. Just think about how often you cross the boundaries of the city or town where you live to go to work, to recreate, or to shop. Three or four times a week, or three or four times a day?

Though we don't identify as such, most Americans are regional citizens living in highly networked yet seemingly invisible regional citysystems. The Seattle metro region, for example, is a large and multi-faceted area encompassing 5,894 square miles. That is almost the size of New York's metro area of 6,720 miles but with 15.5 million fewer people. Seattle metro includes 31 cities and towns and dozens of employment centers.

Amando Carbonell, Senior Planning Fellow at Harvard's Lincoln Land Institute, says:

We live in regions — territories defined primarily by function and only rarely by jurisdiction. The places where we work, live, shop, recreate, and socialize constitute a territory that seldom corresponds to a single town or city. Regional planning is concerned less with the exercise of jurisdiction and more with the search for new forms of habitation based on a clear commitment to advancing sustainability.

Even if we do live and work in the same town, the ecological fall out of our day-to-day living patterns will be felt upstream and downstream throughout the region, not to mention the ecological footprint.

And now my central point: a regional approach is necessary for managing land use, water, utilities, population growth, and transportation, and ultimately for addressing climate change.

Take the City of Seattle's audacious goal of achieving carbon neutrality by 2030. Absent from the carbon analysis are contributions from external yet urban-generated sources such as the interstate highways, ferry traffic, and municipal waste hauling — all which extend the carbon footprint well beyond Seattle's political borders. SeaTac airport, for example, generates GHG emissions (largely from jet take-offs and landings) of 4,650,000 metric tons, which is nearly 70 percent of Seattle's total annual output (6.770,000 metric tons).

Who are we fooling? If the goal is to seriously cut carbon emissions and advance urban ecological balance and sustainability, the heavy focus on densifying the urban core of the hub city may be misplaced or way too myopic.

Consider Vancouver, British Columbia, for example, a model of urban densification. Vancouver is leagues ahead of most any other city in North America in both planning for center city urban density and achieving it, through a Living First strategy for downtown Vancouver and comprehensive regional planning (their Living Region Strategy) for the metro area.

With its impressive forest of dense residential high-rises, Vancouver has one of the densest urban cores in North America. Even so, the Metro Vancouver area, just like most metro areas in the U.S., has outstripped the city of Vancouver's growth rate by more than four times that of the center city over the last three decades.

Vancouver has achieved a regional compactness twice that of Seattle's metro area. This has been done through regional comprehensive planning, strong land use controls, and Metro Vancouver's urban rapid transit system with 42 miles track over three lines and 47 stations.

But is this the best model to follow? Most North Americans (not that they can't change) prefer to live in less dense neighborhoods than places like New York city. Or, if they prefer urban density, they may find it difficult to afford. Vancouver, despite its focus on compact growth, is the third most expensive cities in the world to live in (as figured by housing costs measured against median income).

Compared to Vancouver, Seattle feels a lot more suburban with 70 percent of the city's land area comprised of single family homes on sizable lots of 5,000 square feet or more. The land use code, which protects this low density land form, has hardly been touched in over 30 years. Maybe that's why Seattle in 1960 comprised over 60 percent of the metro area population yet today represents less than 17 percent in population. It's not that people left Seattle, but the region grew up around it. Urban growth in metro regions the United States, by and large has vastly outpaced population growth in hub cities, a few of which have seen sharp declines in population.

There's nothing particularly wrong with the concentrated urban growth emphasis. Cities can address multi-sector issues in ways that counties and unincorporated areas cannot. But the plain fact is most cities today are buried in, and inseparable from, the metro areas they are within. And the typical North American city is too small in area (the city limits of San Francisco and Boston are nearly half the land area of Seattle) — and with marginal impact on the regional urban eco-system

My second point: there is more than one type of "sustainable lifestyle," and so to solve the climate crisis future growth does not need to corral everyone to live in the center city.

High-towered city living, although it has become increasing popular among empty nesters and those who can afford the views, is not the only sound environmental option. A regional solution can offer a range of lifestyles and community types without compromising, and possibly even improving, urban/regional ecologies. Suburban cities and towns, where most people in the U.S. live, need to be seen as a large parts of the solution, not the whipping boy of the density ubanistas.

Rather than writing off the suburbs, we need strategies to bring the qualities and conveniences of city life to suburban communities. A well planned and functionally efficient region that combines aggressive conservation strategies, good transit systems, and green technologies can offer many types of sustainable lifestyles and affordable housing options to meet American preferences more sustainably and more broadly.

Says Peter Calthorpe, architect, author, and co-founder of the Congress of New Urbanism, "We now lead regional lives, and our metropolitan form and governance need to reflect the new reality."

There are other compelling reasons, besides accommodating future growth, why regional urban strategies are so desperately needed.

Puget Sound. the second largest marine estuary in the United States, is manifestly the single biggest, most intractable environment challenge facing Washington state today.

The iconic chinook salmon along with 20 other marine animals are endangered, dwindling pods of Orca whales are among the most PCB-contaminated mammals on earth, and entire marine ecosystems are dying off. Millions of pounds of toxic pollution flow into Puget Sound every year, mostly from storm water run-off and combined sewer overflows, carrying deadly poisonous chemicals from urban areas to the sea.

Now here's the problem: The Puget Sound basin, home to 4.4 million people, is bordered by 90 cities and towns and an unfathomable maze of overlapping jurisdictions and regulatory agencies. They share in common a local economy (Boeing, Microsoft, global container shipping, etc) and networked urban infrastructure (airports, roads, utilities, energy, water, food distribution network, etc.). Yet no one agency controls. As

Kathy Fletcher, founder and retiring director of People for Puget Sound, says, " our biggest challenge now is the fragmentation of decision-making and lack of enforcement of existing regulations."

It's been over four decades since Sen. Warren G. Magnuson first warned of a looming "environmental catastrophe" facing Puget Sound, meaning oil tankers. Today, it's not the oil tankers but unmanaged urbanization that is the single biggest contributor to the ill-health of the Sound. What would Glaeser and the build-upward urbanists say about that? Cities of today, regardless of how compact they are, do not contain their hazardous wastes from spilling into and destroying fragile ecosystems. The spread of hard impervious pavement, the proliferation of cars, trucks, and steady increasing vehicle travel (VMT) is, more than any other source, causing the continuous poisoning of Puget Sound and its estuaries that the urbanized areas encompass.

Bill Ruckelshaus, former EPA head and past chair of the Puget Sound Partnership, grew frustrated at the slow pace of clean up efforts and suggested convening regulators and others to come up with a more cost-effective way to improve water quality in urban areas like Seattle and King County. It hasn't happened. More recently, Ruckelshaus said in response to failing water quality and clean up efforts in the Puget Sound Basin, "Governance is the screaming need here. We need an intervention!"

This makes my Third Point: Puget's Sound's failing health is symptomatic not of a collective lack of will, but of our politically fractured urban metropolis . It's the sydrome known as the tragedy of the commons. Consider this: By 2040, the region is expected to grow by nearly 2 million more people. The decline of Puget Sound will accelerate unless a regional low-impact growth strategy is put in place and enforced across multiple jurisdictional boundaries. The state so far has steadfastly refused to impose necessary regulatory restrictions of polluter fee collections. The marine die-off will continue until there is a Puget Sound-size solution to deal with the enormous problem.

So what can be done about it? Simple. Fill the governance gap. Implementing a bold plan for the future requires coordination and consolidation of local power into a new regional form of governance.

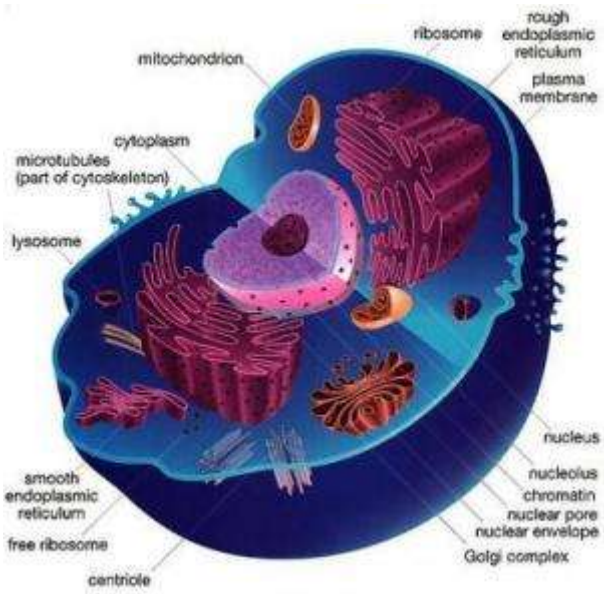
The place to start is recognize the region's common economic, social, and environmental interests, and by building strategic institutional alliances that knit metro communities together across jurisdictional boundaries. I'd suggest a Congress of Puget Sound, consisting of democratically elected representatives of municipalities, as a strong, common voice for the region while preserving local independence at the municipal level.

Rather than be divided through prolonged infighting and turf wars, why not create an institutional mechanism for intra-local priority-setting and inter-local decision-making that can transform the metropolitan areas such as the Puget Sound basin into much stronger strategic regions? After all this was the genesis of the European Union on a much larger scale.

Such efforts are beginning to form around the country, to address growing complex needs and the governance gap of metro regions, and as a means for advancing economic, social and environmental progress while preserving sense of place.Cities in the 21st century are the future, says economist Jeb Brugmann, and the strategic city-region will have the "urban advantage." The success of cities in tackling global problems will depend on values-driven, transformative urban alliances and progressive strategies that achieve resiliency and greater ecological balance with the planet. Competing interests will need to re-align themselves against chaotic, disorganized, and destructive forces, or face more global crises, ecological disasters, and ultimately sharp economic decline.

http://crosscut.com/2011/09/03/urban/21265/Urbanism-needs-to-move-beyond-city-boundaries/one_page/

New Cellular Surprise May Help Scientists Better Understand Human Mitochondrial Diseases



A new study involving CU-Boulder and UC-Davis may help scientists better understand mitochondrial diseases and conditions. (Credit: NIH)

ScienceDaily (Sep. 7, 2011) — A surprising new discovery by the University of Colorado Boulder and the University of California, Davis regarding the division of tiny "power plants" within cells known as mitochondria has implications for better understanding a wide variety of human diseases and conditions due to mitochondrial defects.

Led by CU-Boulder Assistant Professor Gia Voeltz and her team in collaboration with the UC-Davis team led by Professor Jodi Nunnari, the researchers analyzed factors that regulate the behavior of mitochondria, sausage-shaped organelles within cells that contain their own DNA and provide cells with the energy to move and divide. The dynamics of mitochondrion were intimately tied to another cell organelle known as the endoplasmic reticulum, which is a complex network of sacs and tubules that makes proteins and fats.

Voeltz and her colleagues showed that the division of the mitochondria within cells is tied to the point or points where they are physically touching the endoplasmic reticulum in both yeast and mammalian cells. "This is the first time one cell organelle has been shown to shape another," said Voeltz of CU's molecular, cellular and developmental biology department.

A paper on the study was published in the Sept. 2 issue of the journal *Science*. Co-authors on the study included CU-Boulder graduate student Jonathan Friedman, researcher Matthew West and senior Jared DiBenedetto and UC-Davis postdoctoral researcher Laura Lackner.

Enclosed by membranes, mitochondria vary vastly in numbers per individual cells depending on the organism and tissue type, according to the researchers. While some single-cell organisms contain only a single mitochondrion, a human liver cell can contain up to 2,000 mitochondria and take up nearly one-quarter of the cell space.

Since numerous human diseases are associated with mitochondrial dysfunction, it is important to understand how the division process is regulated, said Voeltz.

Mitochondrial defects have been linked to a wide range of degenerative conditions and diseases, including diabetes, cardiovascular disease and stroke. "Our studies suggest the possibility that human mitochondrial diseases could result from disruption or excessive contact between the endoplasmic reticulum and the mitochondria."

Previous work, including research in Nunnari's lab at UC-Davis, has shown that mitochondrial division is regulated by a protein known as "dynamine-related protein-1" that assembles into a noose-like ligature that tightens around individual mitochondrion, causing it to divide. The team found that several additional proteins linked to mitochondrial division also were found where the endoplasmic reticulum and mitochondria touched.

"The new function for the endoplasmic reticulum expands and transforms our view of cell organization," said Nunnari, a professor and chair of molecular cell biology at UC-Davis. "It's a paradigm shift in cell biology."

The study was funded by the National Institutes of Health, the Searle Scholar Program and CU-Boulder. CU-Boulder's Undergraduate Research Opportunities Program and Bioscience Undergraduate Research Skills and Training program funded the research by DiBenedetto.

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

Journal Reference:

1. J. R. Friedman, L. L. Lackner, M. West, J. R. DiBenedetto, J. Nunnari, G. K. Voeltz. **ER Tubules Mark Sites of Mitochondrial Division**. *Science*, 2011; DOI: 10.1126/science.1207385

http://www.sciencedaily.com/releases/2011/09/110906152505.htm

Premature baby brains can't tell pain from touch

- 17:00 08 September 2011 by **Catherine de Lange**

Fetuses can tell the difference between pain and touch in only the last two weeks before birth, which could help to explain why babies born prematurely often have abnormal pain responses.

Lorenzo Fabrizi from University College London and colleagues used EEG, a non-invasive way of measuring brain activity, on 46 newborn babies as they underwent a routine heel lance – a pinprick to the heel for taking a blood sample.

They also measured how the babies' brains responded to normal touch – a light tap to the heel. Almost half of the babies were born prematurely – some at just 28 weeks – so the team were able to compare the responses of babies in the final stages of development with those of babies born at full term.

Premature babies up to the age of 35 weeks had bursts of activity across the whole brain in response to both pain and touch, but a change happened around 35 weeks. Between 35 to 37 weeks – just before a fetus would normally be born – the brain seemed to become able to tell the two stimuli apart. The responses to both pain and touch now took place in specific areas on the front, back and sides of the brain, but the signal was much stronger for pain.

Welcome to pain

"This is an important stage in the development of the brain," says Fabrizi, when changes occur to allow the brain to process sensory stimulation in a more sophisticated way in preparation for life outside the womb.

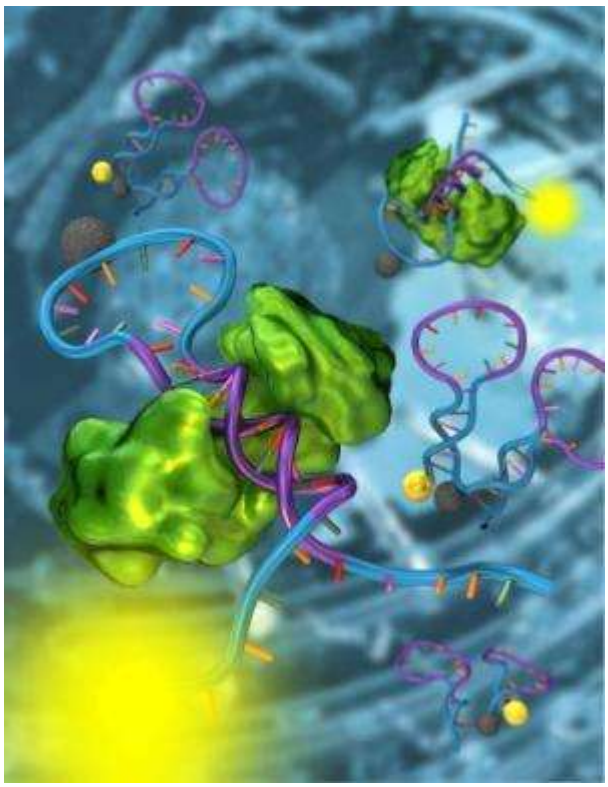
Fabrizi believes that the general bursts of brain activity experienced by developing fetuses are part of that development – they help connections to form between neurons in the brain. That could be a reason to treat premature babies with even more care than usual: "By evoking [bursts of brain activity] when the baby is born prematurely we may be interfering with the normal wiring in the brain," Fabrizi says, adding that premature babies can be subjected to up to 10 painful procedures a day in hospital.

This might explain why children born prematurely have been found to have abnormal pain responses, although the long-term effects remain unclear, says Fabrizi.

Journal reference: *Current Biology*, DOI: 10.1016/j.cub.2011.08.010

http://www.newscientist.com/article/dn20884-premature-baby-brains-cant-tell-pain-from-touch.html?full=true&print=true

Nanosensors Made from DNA May Light Path to New Cancer Tests and Drugs



A structure-switching nanosensor made from DNA (blue and purple) detects a specific transcription factor (green). Using these nanosensors, a team of researchers from UCSB has demonstrated the detection of transcription factors directly in cellular extracts. The researchers believe that their strategies will allow biologists to monitor the activity of thousands of transcription factors, leading to a better understanding of the mechanisms underlying cell division and development. (Credit: Peter Allen)

ScienceDaily (Sep. 7, 2011) — Sensors made from custom DNA molecules could be used to personalize cancer treatments and monitor the quality of stem cells, according to an international team of researchers led by scientists at UC Santa Barbara and the University of Rome Tor Vergata.

The new nanosensors can quickly detect a broad class of proteins called transcription factors, which serve as the master control switches of life. The research is described in an article published in *Journal of the American Chemical Society*.

"The fate of our cells is controlled by thousands of different proteins, called transcription factors," said Alexis Vallée-Bélisle, a postdoctoral researcher in UCSB's Department of Chemistry and Biochemistry, who led the study. "The role of these proteins is to read the genome and translate it into instructions for the synthesis of the various molecules that compose and control the cell. Transcription factors act a little bit like the 'settings' of our cells, just like the settings on our phones or computers. What our sensors do is read those settings."

When scientists take stem cells and turn them into specialized cells, they do so by changing the levels of a few transcription factors, he explained. This process is called cell reprogramming. "Our sensors monitor transcription factor activities, and could be used to make sure that stem cells have been properly reprogrammed," said Vallée-Bélisle. "They could also be used to determine which transcription factors are activated or repressed in a patient's cancer cells, thus enabling physicians to use the right combination of drugs for each patient."

Andrew Bonham, a postdoctoral scholar at UCSB and co-first author of the study, explained that many labs have invented ways to read transcription factors; however, this team's approach is very quick and convenient. "In most labs, researchers spend hours extracting the proteins from cells before analyzing them," said Bonham. "With the new sensors, we just mash the cells up, put the sensors in, and measure the level of fluorescence of the sample."

This international research effort -- organized by senior authors Kevin Plaxco, professor in UCSB's Department of Chemistry and Biochemistry, and Francesco Ricci, professor at the University of Rome, Tor Vergata -- started when Ricci realized that all of the information necessary to detect transcription factor activities is already encrypted in the human genome, and could be used to build sensors. "Upon activation,

these thousands of different transcription factors bind to their own specific target DNA sequence," said Ricci. "We use these sequences as a starting point to build our new nanosensors."

The key breakthrough underlying this new technology came from studies of the natural biosensors inside cells. "All creatures, from bacteria to humans, monitor their environments using 'biomolecular switches' -- shape-changing molecules made from RNA or proteins," said Plaxco. "For example, in our sinuses, there are millions of receptor proteins that detect different odor molecules by switching from an 'off state' to an 'on state.' The beauty of these switches is that they are small enough to operate inside a cell, and specific enough to work in the very complex environments found there."

Inspired by the efficiency of these natural nanosensors, the research group teamed with Norbert Reich, also a professor in UCSB's Department of Chemistry and Biochemistry, to build synthetic switching nanosensors using DNA, rather than proteins or RNA.

Specifically, the team re-engineered three naturally occurring DNA sequences, each recognizing a different transcription factor, into molecular switches that become fluorescent when they bind to their intended targets. Using these nanometer-scale sensors, the researchers could determine transcription factor activity directly in cellular extracts by simply measuring their fluorescence level.

The researchers believe that this strategy will ultimately allow biologists to monitor the activation of thousands of transcription factors, leading to a better understanding of the mechanisms underlying cell division and development. "Alternatively, since these nanosensors work directly in biological samples, we also believe that they could be used to screen and test new drugs that could, for example, inhibit transcription-factor binding activity responsible for the growth of tumor cells," said Plaxco.

This work was funded by the National Institute of Health, the Fond Québécois de la Recherche sur la Nature et les Technologies, the Italian Ministry of University and Research (MIUR) project "Futuro in Ricerca," and the Tri-County Blood Bank Santa Barbara Foundation.

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Story Source:

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

Journal Reference:

1. Alexis Vallée-Bélisle, Andrew J. Bonham, Norbert O. Reich, Francesco Ricci, Kevin W. Plaxco. **Transcription Factor Beacons for the Quantitative Detection of DNA Binding Activity**. *Journal of the American Chemical Society*, 2011; 133 (35): 13836 DOI: 10.1021/ja204775k

http://www.sciencedaily.com/releases/2011/09/110907132106.htm

Warming seas could smother seafood

- 14:01 08 September 2011 by **Debora MacKenzie**

Catch them while you can (Image: Hiroya Minakuchi/Minden Pictures/FLPA)

Seafood could be going off a lot of menus as the world warms. More than half of a group of fish crucial for the marine food web might die if, as predicted, global warming reduces the amount of oxygen dissolved in some critical areas of the ocean – including some of our richest fisheries.

The prediction is based on a unique set of records that goes back to 1951. California has regularly surveyed its marine plankton and baby fish to support the sardine fishery. "There is almost no other dataset going back so far that includes every kind of fish," says Tony Koslow of the Scripps Institution of Oceanography in La Jolla, California, who heads the survey. The survey records also include information on water temperature, salinity and the dissolved oxygen content.

Koslow's team studied records of 86 fish species found consistently in the samples and discovered that the abundance of 27 of them correlated strongly with the amount of oxygen 200 to 400 metres down: a 20 per cent drop in oxygen meant a 63 per cent drop in the fish. There have been several episodes of low oxygen during the period in question, mainly in the 1950s and since 1984.

Global climate models predict that 20 to 40 per cent of the oxygen at these depths will disappear over the next century due to warming, says Koslow – mainly because these waters get oxygen by mixing with surface waters. Warmer, lighter surface waters are less likely to mix with the colder, denser waters beneath.

Of the 27 species most affected by low oxygen, says Koslow, 24 were "mesopelagic": fish that spend the daytime in deep, dark waters below 200 metres to avoid predators such as squid that hunt by sight. There are 10 billion tonnes of mesopelagic fish globally – 10 times the annual global commercial catch – and they are a vital food for other fish and marine birds and mammals.

Out of the depths

In large segments of the Indian, eastern Pacific and Atlantic Oceans called oxygen minimum zones (OMZs), patterns of ocean currents already permit little downward mixing of surface water, so the dark depths where mesopelagics hide have barely enough oxygen for survival. Worldwide, OMZs are expanding both in area and vertically, pushing "hypoxic" water – water with too little oxygen for survival – to ever-shallower levels. Last year, Japanese researchers reported that this has nearly halved the depths inhabited by Pacific cod. The California coast is an OMZ. When oxygen levels are even lower than usual, the hypoxic zone starts up to 90 metres closer to the surface. This means fish must stay in shallower, more brightly lit water, says Koslow, at greater risk from predators – which, he suspects, is what kills them. In the California data, predatory rockfish in fact boomed during periods of low oxygen.

"This is important work," says William Gilly of Stanford University's marine lab in Pacific Grove, California. He studies Humboldt squid, an OMZ predator whose recent movements seem consistent with Koslow's idea.

"These findings are an example of the kinds of changes we will see more broadly throughout our oceans in coming decades, especially in OMZs," says Frank Whitney of the Institute of Ocean Sciences in Sidney, British Columbia, Canada. Unfortunately, he notes, water and nutrient movements within OMZs make them among our richest fishing grounds.

Journal reference: *Marine Ecology Progress Series*, DOI: 10.3354/meps09270

http://www.newscientist.com/article/dn20882-warming-seas-could-smother-seafood.html?full=true&print=true

Compact Fluorescents Not the Only Light of the Future

Response: The editor of Midwest Energy News notes that while CFLs are a common replacement for power-hungry incandescent bulbs, new laws don't mandate their use and their drawbacks are often overstated.

By Ken Paulman

American consumers who don't want to buy CFLs will still be able to purchase advanced incandescent or halogen bulbs (above) that meet the new efficiency rules. (funadium/Flickr)

Well-intentioned journalists, for simplicity's sake, often frame soon-to-be-enacted efficiency standards as a "ban" on incandescent bulbs in favor of compact fluorescents, or CFLs. Michael Scott Moore is the latest to pick up this narrative, which, unfortunately, tends to sow more confusion than clarity.

Specifically, we're referring to the 2007 Energy Independence and Security Act, which sets minimum efficiency standards for household light bulbs, standards similar to those for refrigerators, dishwashers and other appliances. While the law will, in effect, lead to the phasing out of the most commonly used incandescent bulbs, it does not outlaw one technology in favor of another.

American consumers who don't want to buy CFLs will still be able to purchase advanced incandescent or halogen bulbs that meet the new efficiency rules. Some of these bulbs, depending on manufacturer, are virtually indistinguishable from the older-style exposed filament bulbs. And the law specifically exempts a variety of special-application incandescents, including three-way bulbs, appliance bulbs and others.

There are also, of course, LED bulbs, which many expect will eventually displace both halogens and CFLs as the dominant lighting technology.

But to be fair, Moore's point seems to be more to call attention to unanticipated drawbacks of CFLs. His criticisms, while legitimate, warrant some additional perspective.

To begin with, it seems a bit premature to conclude that CFLs will fail to live up to longevity claims simply because Moore had one single bulb burn out after six months. My equally unscientific anecdotal evidence suggests they will last several years, depending on application.

This bit of faulty logic is less concerning to me than the specter Moore raises over mercury exposure.

It's well known that CFL bulbs contain a small amount of mercury, and Moore correctly notes that the EPA recommends a rather elaborate cleanup procedure in the event one of them breaks. But how much mercury are we really talking about?

Comparing bulbs to thermometers is, at best, misleading. A typical CFL bulb contains anywhere from 2 to 5 mg of mercury, compared to the 500 mg found in a thermometer. And when a bulb is broken, only a small percentage of that mercury is actually released.

While no amount of mercury exposure is healthy, the threat from CFL bulbs is miniscule compared to the amount of mercury that is currently released into the air and water from power plants. Each year, coal plants in the United States emit an amount of mercury equivalent to 8 billion CFL bulbs, and the EPA has estimated that if every single CFL bulb sold in the U.S. in 2009 was broken, it would increase overall mercury emissions a mere 0.12 percent.

In fact, because they use less coal-fired electricity, each CFL bulb used in the United States results in an overall net reduction in mercury emissions, according to the EPA. It stands to reason this would also hold true in Germany, which still relies on coal for a significant percentage of its electricity.

There's a legitimate discussion to be had about the effectiveness of light bulb efficiency standards and the potential for undesired consequences. But it's also important to have a little perspective.

http://www.miller-mccune.com/environment/compact-fluorescents-not-the-only-light-of-the-future-35897/

Dolphins call each other by name

- 12:52 07 September 2011 by **Michael Marshall**
- Magazine issue 2829.

Sorry, I didn't catch your whistle (Image: David Sanger/Getty)

Dave the dolphin whistles, and his friend Alan whistles back. We can't yet decipher their calls, but some of the time Dave may be calling: "Alan! Alan! Alan! Alan!"

Stephanie King of the University of St Andrews, UK, and colleagues monitored 179 pairs of wild bottlenose dolphins off the Florida coast between 1988 and 2004. Of these, 10 were seen copying each other's signature whistles, which the dolphins make to identify themselves to each other.

The behaviour has never been documented before, and was only seen in pairs composed of a mother and her calf or adults who would normally move around and hunt together.

The copied whistles changed frequency in the same way as real signature whistles, but either started from a higher frequency or didn't last as long, suggesting Dave was not merely imitating Alan.

Copying only happened when a pair had become separated, which leads King to speculate that they were trying to get back together. She believes the dolphins were mimicking another animal's whistle as a way of calling them by name.

King presented her research last week at the summer conference of the Association for the Study of Animal Behaviour in St Andrews.

Justin Gregg of the Dolphin Communication Project in Old Mystic, Connecticut, remains cautious, and points out that the dolphins may copy the signature whistles simply because they hear them a lot. To be sure that they are using the whistles to refer to a specific individual, researchers would need to show that dolphins responded when their signature whistle was copied, he says.

There is no other species that is known to combine signature calls and vocal mimicry in this way, says Phyllis Lee of the University of Stirling, UK. "But I bet parrots could do it," she adds. "They have very long lifespans and complex social structures, and they do a lot of mimicry."

Dolphins don't whistle

Signature they may be, but it appears that dolphins' whistles aren't actually whistles. A true whistle relies on pushing air through a chamber, but a similar sound can be produced by a vibrating membrane.

To find out which way dolphins do it, Peter Madsen of Aarhus University in Denmark and colleagues recorded a bottlenose dolphin whistling after breathing helium. The sounds were largely the same whether the dolphin was breathing helium or air. If the dolphin was really whistling, the helium would have changed the frequency of the sound (*Biology Letters*, DOI: 10.1098/rsbl.2011.0701).

http://www.newscientist.com/article/dn20874-dolphins-call-each-other-by-name.html?full=true&print=true

Evidence for a Persistently Iron-Rich Ocean Changes Views On Earth's Early History

The team finds unweathered samples of black shale along a narrow road cutting through the hills north of Beijing. (Credit: Chu Research Group, Institute of Geology and Geophysics, Chinese Academy of Sciences.)

ScienceDaily (Sep. 7, 2011) — Over the last half a billion years, the ocean has mostly been full of oxygen and teeming with animal life. But earlier, before animals had evolved, oxygen was harder to come by. Now a new study led by researchers at the University of California, Riverside reveals that the ancient deep ocean was not only devoid of oxygen but also rich in iron, a key biological nutrient, for nearly a billion years longer than previously thought -- right through a key evolutionary interval that culminated in the first rise of animals.

"The implications of our work are far reaching," said Timothy Lyons, a professor of biogeochemistry and the principal investigator of the study. "We will need to rethink, in a fundamental way, all of our models for how life-essential nutrients were distributed in the ocean through time and space."

Study results appear in the Sept. 8 issue of *Nature*.

Previous ocean chemistry models

Most scientists agree that the early Earth, before 2.4 billion years ago, contained only trace quantities of oxygen and that the oceans were dominantly full of dissolved iron. But there is far less agreement among scientists about the chemical composition of the ocean during the middle chapters of Earth's history in the wake of atmospheric oxygenation -- about 2.4 to 0.5 billion years ago -- when the diversity of organisms that we know today, including the animals, first got their footing.

Classic models for this time window maintain that the ocean, all depths, became rich in oxygen in parallel with its first accumulation in the atmosphere. This increase in oxygen in seawater has been linked to the disappearance of iron ore deposits known as 'banded iron formations,' the source of almost all of the iron used to make steel today. Oxygen, the argument goes, would have 'rusted' the oceans, stripping them of dissolved iron.

More than a decade ago, however, another idea gained traction: hydrogen sulfide. Produced by bacteria in the absence of oxygen, hydrogen sulfide, it was argued, might instead have scrubbed the iron out of the ocean during Earth's middle history, dealing the fatal blow to the iron deposits. In an ocean full of hydrogen sulfide, diverse life-sustaining elements, including iron, can be stripped from the seawater, potentially causing a biotic crisis.

Fresh perspective

"The problem all along was a general lack of physical evidence in the oceans for the amounts of oxygen, iron, and sulfide in the Earth's middle history, particularly in a critical billion-year window between roughly 1.8 and 0.8 billion years ago," said Noah Planavsky, a doctoral student in UC Riverside's Department of Earth Sciences and the lead author of the new study. "Some earlier work supported a return to an iron-rich ocean 0.8 billion years ago. Rather than a return, however, we predicted that iron may have dominated the deep ocean continuously right up to the oxygenation and concomitant rise of animals a mere half-billion years ago."

Planavsky and his colleagues at UCR and in Canada, Australia, and China sought to remedy the data deficiency. New rock samples they collected from across the globe suggest a previously unknown continuity in ocean chemistry over much of its history. These data, the first of their kind, point towards continuous oxygen-poor, iron-rich conditions for 90 percent of Earth's history, with oxygen and hydrogen sulfide, when present, limited mostly to the surface layers and along the margins of the oceans, respectively.

The task now is to reconsider whether the purported shortages of nutrients attributed to widespread hydrogen sulfide were indeed real and a throttle on early evolution. "Our new knowledge that the deep ocean was anoxic and iron-rich does not mean life had it easy, though," Lyons says. "Enough sulfide could have persisted around the edges of the ocean to severely limit other key nutrients. We are still testing this hypothesis."

Ironing out the details

The researchers' results also indicate that neither oxygen nor hydrogen sulfide turned off iron deposition around 1.8 billion years ago, when the last major iron ores were seen. They suggest instead that hydrothermal systems on the seafloor are the most important factor controlling the distribution of iron ore.

"These hydrothermal systems are high-temperature vents on the seafloor tied to magmatic activity, and they can pump huge amounts of iron into the ocean," Planavsky explained. "Previous researchers have suggested that there was a decrease in the amount of iron from hydrothermal systems around 1.8 billion years ago. Our results support this idea with compelling physical evidence, while showing that iron could persist in the ocean at levels below those necessary to form ore deposits."

"The next step is to better merge this refined chemical perspective with traditional and emerging views of evolving life, recognizing that life and the environment co-evolve in an intimate dance of cause-and-effect relationships," Lyons added.

Planavsky and Lyons were joined in the study by Clint Scott, Chao Li, Chris Reinhard, Amy Kelly, and Gordon Love, all colleagues at UCR; Peter McGoldrick of the University of Tasmania; Xuelei Chu of the Chinese Academy of Sciences; and Andrey Bekker of the University of Manitoba, Canada.

The study was supported by grants to Planavsky from the National Science Foundation-Graduate Research Fellowship Program, the Geological Society of America and the American Philosophical Society; and to Lyons from the National Science Foundation-Geobiology and Low-Temperature Geochemistry Program, the NASA Exobiology Program, the NASA Astrobiology Institute, the University of Tasmania Visiting Fellows Program and the Agouron Institute.

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Journal Reference:

1. Noah J. Planavsky, Peter McGoldrick, Clinton T. Scott, Chao Li, Christopher T. Reinhard, Amy E. Kelly, Xuelei Chu, Andrey Bekker, Gordon D. Love, Timothy W. Lyons. **Widespread iron-rich conditions in the mid-Proterozoic ocean**. *Nature*, 2011; DOI: 10.1038/nature10327

http://www.sciencedaily.com/releases/2011/09/110907132052.htm

Quantum minds: Why we think like quarks

- 05 September 2011 by **Mark Buchanan**

Magazine issue 2828.

When errors make sense (Image: Paul Wesley Griggs)

The fuzziness and weird logic of the way particles behave applies surprisingly well to how humans think

THE quantum world defies the rules of ordinary logic. Particles routinely occupy two or more places at the same time and don't even have well-defined properties until they are measured. It's all strange, yet true - quantum theory is the most accurate scientific theory ever tested and its mathematics is perfectly suited to the weirdness of the atomic world.

Yet that mathematics actually stands on its own, quite independent of the theory. Indeed, much of it was invented well before quantum theory even existed, notably by German mathematician David Hilbert. Now, it's beginning to look as if it might apply to a lot more than just quantum physics, and quite possibly even to the way people think.

Human thinking, as many of us know, often fails to respect the principles of classical logic. We make systematic errors when reasoning with probabilities, for example. Physicist Diederik Aerts of the Free University of Brussels, Belgium, has shown that these errors actually make sense within a wider logic based on quantum mathematics. The same logic also seems to fit naturally with how people link concepts together,

often on the basis of loose associations and blurred boundaries. That means search algorithms based on quantum logic could uncover meanings in masses of text more efficiently than classical algorithms.

It may sound preposterous to imagine that the mathematics of quantum theory has something to say about the nature of human thinking. This is not to say there is anything quantum going on in the brain, only that "quantum" mathematics really isn't owned by physics at all, and turns out to be better than classical mathematics in capturing the fuzzy and flexible ways that humans use ideas. "People often follow a different way of thinking than the one dictated by classical logic," says Aerts. "The mathematics of quantum theory turns out to describe this quite well."

It's a finding that has kicked off a burgeoning field known as "quantum interaction", which explores how quantum theory can be useful in areas having nothing to do with physics, ranging from human language and cognition to biology and economics. And it's already drawing researchers to major conferences.

One thing that distinguishes quantum from classical physics is how probabilities work. Suppose, for example, that you spray some particles towards a screen with two slits in it, and study the results on the wall behind (see diagram). Close slit B, and particles going through A will make a pattern behind it. Close A instead, and a similar pattern will form behind slit B. Keep both A and B open and the pattern you should get - ordinary physics and logic would suggest - should be the sum of these two component patterns.

But the quantum world doesn't obey. When electrons or photons in a beam pass through the two slits, they act as waves and produce an interference pattern on the wall. The pattern with A and B open just isn't the sum of the two patterns with either A or B open alone, but something entirely different - one that varies as light and dark stripes.

Such interference effects lie at the heart of many quantum phenomena, and find a natural description in Hilbert's mathematics. But the phenomenon may go well beyond physics, and one example of this is the violation of what logicians call the "sure thing" principle. This is the idea that if you prefer one action over another in one situation - coffee over tea in situation A, say, when it's before noon - and you prefer the same thing in the opposite situation - coffee over tea in situation B, when it's after noon - then you should have the same preference when you don't know the situation: that is, coffee over tea when you don't know what time it is.

Remarkably, people don't respect this rule. In the early 1990s, for example, psychologists Amos Tversky and Eldar Shafir of Princeton University tested the idea in a simple gambling experiment. Players were told they had an even chance of winning $200 or losing $100, and were then asked to choose whether or not to play the same gamble a second time. When told they had won the first gamble (situation A), 69 per cent of the participants chose to play again. If told they had lost (situation B), only 59 per cent wanted to play again. That's not surprising. But when they were not told the outcome of the first gamble (situation A or B), only 36 per cent wanted to play again.

Classical logic would demand that the third probability equal the average of the first two, yet it doesn't. As in the double slit experiment, the simultaneous presence of two parts, A and B, seems to lead to some kind of weird interference that spoils classical probabilities.

Flexible logic

Other experiments show similar oddities. Suppose you ask people to put various objects, such as an ashtray, a painting and a sink, into one of two categories: "home furnishings" and "furniture". Next, you ask if these objects belong to the combined category "home furnishings or furniture". Obviously, if "ashtray" or "painting" belongs in home furnishings, then it certainly belongs in the bigger, more inclusive combined

category too. But many experiments over the past two decades document what psychologists call the disjunction effect - that people often place things in the first category, but not in the broader one. Again, two possibilities listed simultaneously lead to strange results.

These experiments demonstrate that people aren't logical, at least by classical standards. But quantum theory, Aerts argues, offers richer logical possibilities. For example, two quantum events, A and B, are described by so-called probability amplitudes, alpha and beta. To calculate the probability of A happening, you must square this amplitude alpha and likewise to work out the probability of B happening. For A or B to happen, the probability amplitude is alpha plus beta. When you square this to work out the probability, you get the probability of A (alpha squared) plus that of B (beta squared) plus an additional amount - an "interference term" which might be positive or negative.

This interference term makes quantum logic more flexible. In fact, Aerts has shown that many results demonstrating the disjunction effect fit naturally within a model in which quantum interference can play a role. The way we violate the sure thing principle can be similarly explained with quantum interference, according to economist Jerome Busemeyer of Indiana University in Bloomington and psychologist Emmanuel Pothos of the University of Wales in Swansea. "Quantum probabilities have the potential to provide a better framework for modelling human decision making," says Busemeyer.

The strange links go beyond probability, Aerts argues, to the realm of quantum uncertainty. One aspect of this is that the properties of particles such as electrons do not exist until they are measured. The experiment doing the measuring determines what properties an electron might have.

Hilbert's mathematics includes this effect by representing the quantum state of an electron by a so-called "state vector" - a kind of arrow existing in an abstract, high-dimensional space known as Hilbert space. An experiment can change the state vector arrow, projecting it in just one direction in the space. This is known as contextuality and it represents how the context of a specific experiment changes the possible properties of the electron being measured.

The meaning of words, too, changes according to their context, giving language a "quantum" feel. For instance, you would think that if a thing, X, is also a Y, then a "tall X" would also be a "tall Y" - a tall oak is a tall tree, for example. But that's not always the case. A chihuahua is a dog, but a tall chihuahua is not a tall dog; "tall" changes meaning by virtue of the word next to it. Likewise, the way "red" is defined depends on whether you are talking about "red wine", "red hair", "red eyes" or "red soil". "The structure of human conceptual knowledge is quantum-like because context plays a fundamental role," says Aerts.These peculiar similarities also apply to how search engines retrieve information. Around a decade ago, computer scientists Dominic Widdows, now at Google Research in Pittsburgh, Pennsylvania, and Keith van Rijsbergen of the University of Glasgow, UK, realised that the mathematics they had been building into search engines was essentially the same as that of quantum theory.

Quantum leaps

It didn't take long for them to find they were on to something. An urgent challenge is to get computers to find meaning in data in much the same way people do, says Widdows. If you want to research a topic such as the "story of rock" with geophysics and rock formation in mind, you don't want a search engine to give you millions of pages on rock music. One approach would be to include "-songs" in your search terms in order to remove any pages that mention "songs". This is called negation and is based on classical logic. While it would be an improvement, you would still find lots of pages about rock music that just don't happen to mention the word songs.

Widdows has found that a negation based on quantum logic works much better. Interpreting "not" in the quantum sense means taking "songs" as an arrow in a multidimensional Hilbert space called semantic space,

where words with the same meaning are grouped together. Negation means removing from the search pages that shares any component in common with this vector, which would include pages with words like music, guitar, Hendrix and so on. As a result, the search becomes much more specific to what the user wants.

"It seems to work because it corresponds more closely to the vague reasoning people often use when searching for information," says Widdows. "We often rely on hunches, and traditionally, computers are very bad at hunches. This is just where the quantum-inspired models give fresh insights."

That work is now being used to create entirely new ways of retrieving information. Widdows, working with Trevor Cohen at the University of Texas in Houston, and others, has shown that quantum operations in semantic Hilbert spaces are a powerful means of finding previously unrecognised associations between concepts. This may even offer a route towards computers being truly able to discover things for themselves.

To demonstrate how it might work, the researchers started with 20 million sets of terms called "object-relation-object triplets", which Thomas Rindflesch of the National Institutes of Health in Bethesda, Maryland, had earlier extracted from a database of biomedical journal citations. These triplets are formed from pairs of medical terms that frequently appear in scientific papers, such as "amyloid beta-protein" and "Alzheimer's disease", linked by any verb that means "associated with".The researchers then create a multi-dimensional Hilbert space with state vectors representing the triplets and applied quantum mathematics to find other state vectors that, loosely speaking, point in the same direction. These new state vectors represent potentially meaningful triplets not actually present in the original list. Their approach makes "logical leaps" or informed hypotheses about pairs of terms, which are outside the realms of classic logic but seem likely promising avenues for further study. "We're aiming to augment scientists' own mental associations with associations that have been learned automatically from the biomedical literature," says Cohen.

He and his colleagues then asked medical researchers to use the approach to generate hypotheses and associations beyond what they could come up with on their own. One of them, molecular biologist Graham Kerr Whitfield of the University of Arizona in Phoenix, used it to explore the biology of the vitamin D receptor and its role in the pathogenesis of cancer. It suggested a possible link between a gene called *ncor-1* and the vitamin D receptor, something totally unexpected to Kerr Whitfield, but now the focus of experiments in his lab.Yet one big question remains: why should quantum logic fit human behaviour? Peter Bruza at Queensland University of Technology in Brisbane, Australia, suggests the reason is to do with our finite brain being overwhelmed by the complexity of the environment yet having to take action long before it can calculate its way to the certainty demanded by classical logic. Quantum logic may be more suitable to making decisions that work well enough, even if they're not logically faultless. "The constraints we face are often the natural enemy of getting completely accurate and justified answers," says Bruza.

This idea fits with the views of some psychologists, who argue that strict classical logic only plays a small part in the human mind. Cognitive psychologist Peter Gardenfors of Lund University in Sweden, for example, argues that much of our thinking operates on a largely unconscious level, where thought follows a less restrictive logic and forms loose associations between concepts.Aerts agrees. "It seems that we're really on to something deep we don't yet fully understand." This is not to say that the human brain or consciousness have anything to do with quantum physics, only that the mathematical language of quantum theory happens to match the description of human decision-making.Perhaps only humans, with our seemingly illogical minds, are uniquely capable of discovering and understanding quantum theory. To be human is to be quantum.

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http://www.newscientist.com/article/mg21128285.900-quantum-minds-why-we-think-like-quarks.html?full=true&print=true

Beyond PTSD: Soldiers Have Injured Souls

Now that modern militaries accept that war creates psychological trauma, therapists wonder about its toll on the spirit.

By Diane Silver

What's diagnosed as PTSD may sometimes be more accurately called a moral injury. (Illustration by David Senior)

John Fisher got his soul back when he visited a cemetery in Greece.

Shelley Corteville felt "rocketed" into healing when she told her story at a veterans' retreat after 28 years of silence.

Bob Cagle lost his decades-long urge to commit suicide after an encounter at a Buddhist temple.

These veterans and thousands like them grapple with what some call "the war after the war" — the psychological scars of conflict. Working with the U.S. Department of Veterans Affairs and private organizations, these men and women are employing treatments both radically new and centuries old. At the center of their journey is a new way of thinking that redefines some traumas as moral injuries.

The psychological toll taken by war is obvious. For the second year in a row, more active-duty troops committed suicide in 2010 (468) than were killed in combat in Iraq and Afghanistan (462). A 2008 RAND Corporation study reported that nearly 1 in 5 troops who had returned from Iraq and Afghanistan reported symptoms of post-traumatic stress or major depression.

Since the American Psychiatric Association added post-traumatic stress disorder, or PTSD, to its diagnostic manual in 1980, the diagnosis has most often focused on trauma associated with threats *to* a soldier's life. Today, however, therapists such as Jonathan Shay, a retired VA psychiatrist and recipient of a MacArthur Foundation "genius" grant; Edward Tick, director of the private group Soldier's Heart; and Brett Litz, a VA psychologist, argue that this concept is too limited. What sometimes happens in war may more accurately be

called a moral injury — a deep soul wound that pierces a person's identity, sense of morality and relationship to society. In short, a threat *in* a solder's life.

"My colleagues and I suspect that the greatest lasting harm is from moral injury," says Litz, director of the Mental Health Core of the Massachusetts Veterans Epidemiological Research and Information Center. He and six colleagues published an article on the topic in the December 2009 *Clinical Psychological Review*, in which they define moral injury as a wound that can occur when troops participate in, witness or fall victim to actions that transgress their most deeply held moral beliefs.

While the severity of this kind of wound differs from person to person, moral injury can lead to deep despair.

"They have lost their sense that virtue is even possible," Shay says. "It corrodes the soul."

Litz acknowledges that the idea of moral injury is "controversial and provocative." Neither the military, VA nor the American Psychiatric Association have sanctioned this as a diagnosis, but the concept is gaining traction. In April, psychologists, officers and chaplains led a plenary session on the topic at the Navy and Marine Corps Combat and Operational Stress Control Conference in San Diego.

In Europe, post-traumatic stress disorder researcher Ulrike Schmidt even seeks evidence of the moral injury in brain tissue itself. As she told Miller-McCune.com recently, "They need to know that it's a recognized disorder. They are not weak, they're sick, they have a spiritual wound. … And it's important that they aren't treated like outsiders, which is how many soldiers were treated in Europe in the '40s and '50s."

SELF-INDICTMENT

Georgetown University ethics professor Nancy Sherman heard stories of moral trauma when she interviewed veterans of Iraq, Afghanistan, Vietnam and World War II for her 2010 book, *The Untold War*. "It might be where you felt you should have been able to do more for your buddies, but you couldn't, or because you simply survived," she says.

"Regret," she writes, "doesn't begin to capture what the soldiers I talked with feel. It doesn't capture the despair or depth of the feeling — the awful weight of self-indictment and the need to make moral repair in order to be allowed back into the community in which he feels he has somehow jeopardized his standing."

Vietnam veterans John Fisher and Bob Cagle know that weight. Fisher served as a forward artillery observer and assistant gunner in 1968 and 1969. He vividly remembers the first time he shot an enemy soldier.

"I realized that I had taken his soul away from him," Fisher says. "In the process, my soul was gone."

Cagle served as an infantryman from 1965 to 1966. When he first killed a soldier in combat, he immediately thought of the commandment: "Thou shalt not kill."

"Well, I guess I screwed that up," Cagle told himself at the time. "God will never forgive me."

When Cagle saw the body and realized that his enemy looked no older than 14, his guilt deepened. "He would have shot me in a heartbeat, I had no doubt, but I just couldn't get over that."

Fisher and Cagle came home to thoughts of suicide. "I literally couldn't condone any of the things I had to participate in to save my own life," Fisher says.

Although both eventually found successful careers (Fisher as a chiropractor and Cagle as a respiratory therapist), they struggled, enduring failed marriages, flashbacks and fits of anger and anxiety.

Moral injury does not always occur on a battlefield. In more than 20 years of treating veterans, MacArthur Fellow Shay concluded that these wounds most often occur when leaders betray soldiers in high-stakes situations, whether or not that occurs in combat.

Shelley Corteville, for example, was an Army air traffic controller from 1978 to 1980 in South Korea, where she was raped five times by a fellow soldier. The fault, she thought, was her own. After all, other soldiers and officers constantly referred to women as "whores or tramps" who were always "asking for it." She did not believe these same officers would punish a rapist, so she kept silent, working side-by-side with the man every day.

After leaving the Army, Corteville drank heavily, married and divorced repeatedly. She moved 58 times and worked at 29 different jobs.

"EVERYTHING LIGHTENED"

Therapists have devised a variety of treatments. Litz and his colleagues represent a traditional approach, using a modified talk therapy where a patient interacts with a therapist in an office. Their approach includes creating a bond between the patient and a therapist who can accept unconditionally and listen "without revulsion." Therapists also guide patients through an imaginary dialogue with a "benevolent moral authority" and help them plan practical tasks to make amends.

Litz and his colleagues tested their therapeutic strategy on 25 active-duty Marines in a pilot project. This summer, they launched a four-year study with 300 Marines struggling with moral injury and other psychological problems.Tick represents a different approach. He sees talk therapy as a dead end. "We can only do so much review and expression and catharsis and processing," he says. "That's all wonderful and necessary, but combat veterans who have participated in destroying the world can be stuck in their grief and in their identity of being a destroyer."

He uses groups where veterans share experiences, but he also turns to ritual, charity work, visits to former battlefields and even a redefinition of what it means to be a soldier.Tick, his wife and co-director, Kate Dahlstedt, and a tiny staff at the nonprofit Soldier's Heart in Troy, N.Y., have worked with several hundred people, including active-duty service members and veterans of Iraq and Afghanistan. At the core of their approach is a redefinition of soldiering based on Tick's research into warrior traditions as discussed in his 2005 book *War and the Soul*.

"In traditional cultures, warriors always came back to tell their stories, to give witness and to do healing ceremonies in front of the entire community," Tick says. "The community witnessed the stories, felt the emotions, carried the burdens with their warriors and transferred responsibility for actions from the warriors to the community."Today, Tick, and veterans and civilians inspired by his book, are attempting to re-create some of those experiences from the past. Volunteer groups in 18 U.S. cities, Canada and Vietnam hold listening circles, where veterans share stories with each other and civilians, and veterans mentor each other. Tick also leads trips to ancient and modern battlefields.

No in-depth data yet exists on the effectiveness of any form of treatment for moral injury. Litz's study is the first large-scale effort to do that; he says some of Tick's methods "make sense conceptually," but he will not comment further without seeing data. So far, most of the evaluation of Tick's results has been anecdotal.

Fisher, Cagle and Corteville have all worked with Soldier's Heart.

Corteville, 51, of Springfield, Ore., went to her first retreat in 2009. She had already been through five years of counseling with the VA and been sober for 17 years. “In all that time, I still hadn’t dealt with my PTSD,” she says.

At the retreat, Corteville finally talked about being raped. “That very first retreat is what rocketed me into healing.” As a result, she left a failing marriage and is working on a degree in sociology.

Fisher, 63, of Murrells Inlet, S.C., contacted Tick after reading his book. Despite years of therapy, Fisher was still “waking up in the middle of the night screaming.” Fisher’s breakthrough came when he accompanied Tick to Greece, and they visited the Kerameikos cemetery.

Fisher sat on a knoll and listened as Tick read an oration for the war dead that had been delivered on the same spot 2,500 years before. Fisher says he felt like he was floating, and he realized that his soul, his sense of self, had fled his body while he was in Vietnam. “My heart felt like it was dark inside before. Now it felt like someone had turned on the light.”

Fisher returned home and ended a bad marriage. Today, he leads Soldier’s Heart trips to Vietnam, where veterans meet former foes and conduct charity projects.

Cagle, 65, of Atlanta, views healing as a process. For him, the most useful activity has been writing about his experiences. But the turning point came when he returned to Vietnam with Tick. At first, the trip was a nightmare, as Cagle suffered constant flashbacks and saw visions of the young soldier he had killed. Eventually, the group climbed to a Buddhist temple on a mountain. While the others took off their shoes, Cagle looked up and saw the boy.

“I don’t even know how to describe it.” Cagle struggles to speak as he retells the story. “I’m trying to get my voice back.” He pauses. “Ed [Tick] came over and said, ‘Let’s go on in.’

“I said, ‘You don’t see him, do you?’

“Ed said, ‘Who?’

“I said, ‘That’s the boy I shot.’

“Ed said, ‘What’s going on?’

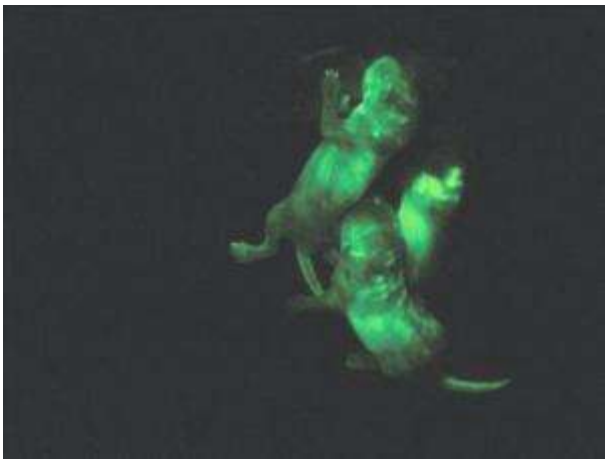
“I said, ‘I think we’re talking to one another on some level I don’t get.’”

Cagle says he felt a crushing weight slip off his shoulders. “From then on, my whole everything lightened. I felt relieved. I felt like this kid could finally go wherever he was supposed to go. That’s when I really started healing.”

Today, Cagle helps run Veterans Heart Georgia. Healing takes time, but it is possible, he says. “It’s not a group of 500 people getting together and having some great epiphany. It’s a one-on-one process. It’s people who care about one another, who are trying to heal themselves and others.”

http://www.miller-mccune.com/culture/beyond-ptsd-soldiers-have-injured-souls-34293/

Scientists Create Mammalian Cells With Single Chromosome Set



Scientists at the University of Cambridge bred mice with fluorescent green cells derived from haploid (single chromosome set) embryonic stem cells. (Credit: Anton Wutz and Martin Leeb, University of Cambridge/Nature)

ScienceDaily (Sep. 7, 2011) — Researchers have created mammalian cells containing a single set of chromosomes for the first time in research funded by the Wellcome Trust and EMBO. The technique should allow scientists to better establish the relationships between genes and their function.

Mammal cells usually contain two sets of chromosomes -- one set inherited from the mother, one from the father. The genetic information contained in these chromosome sets helps determine how our bodies develop. Changes in this genetic code can lead to or increase the risk of developing disease.

To understand how our genes function, scientists manipulate the genes in animal models -- such as the fruit fly, zebrafish and mice -- and observe the effects of these changes. However, as each cell contains two copies of each chromosome, determining the link between a genetic change and its physical effect -- or 'phenotype' -- is immensely complex.

Now, in research published in the journal *Nature*, Drs Anton Wutz and Martin Leeb from the Wellcome Trust Centre for Stem Cell Research at the University of Cambridge report a technique which enables them to create stem cells containing just a single set of chromosomes from an unfertilised mouse egg cell. The stem cells can be used to identify mutations in genes that affect the cells' behaviour in culture. In an additional step, the cells can potentially be implanted into the mouse for studying the change in organs and tissues.

The technique has previously been used in zebrafish, but this is the first time it has been successfully used to generate such mammalian stem cells.

Dr Wutz, a Wellcome Trust Senior Research Fellowship, explains: "These embryonic stem cells are much simpler than normal embryonic mammalian stem cells. Any genetic change we introduce to the single set of chromosomes will have an easy-to-determine effect. This will be useful for exploring in a systematic way the signalling mechanisms within cell and how networks of genes regulate development."

The researchers hope that this technique will help advance mammalian genetics and our understanding of the gene-function relationship in the same way that a similar technique has helped geneticists understand the simpler zebrafish animal model.

Understanding how our genetic make-up functions and how this knowledge can be applied to improve our health is one of the key strategic challenges set out by the Wellcome Trust. Commenting on this new study, Dr Michael Dunn, Head of Molecular and Physiological Sciences at the Wellcome Trust, says:

"This technique will help scientists overcome some of the significant barriers that have so far made studying the functions of genes so difficult. This is often the first step towards understanding why mutations lead to disease and, ultimately, to developing new drugs treatments."

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Story Source:

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

Journal Reference:

1. Martin Leeb, Anton Wutz. **Derivation of haploid embryonic stem cells from mouse embryos**. *Nature*, 2011; DOI: 10.1038/nature10448

http://www.sciencedaily.com/releases/2011/09/110907132047.htm

Growing Meat in the Lab: Scientists Initiate Action Plan to Advance Cultured Meat

Muscle stem cells growing in a nutrient gel, on velcro. (Credit: Bart van Overbeeke, Eindhoven University of Technology)

ScienceDaily (Sep. 7, 2011) — Late last week, an international group of scientists took a step closer to their goal to produce cultured meat. They agreed on important common positions about how to bring the research forward during a workshop in Gothenburg, Sweden, arranged by Chalmers University of Technology and the European Science Foundation.

Many technology components are now coming into place in order to realize the concept of cultured meat. This includes a cell source that is possible to use, several alternative processes to turn these cells into muscle cells for meat, and nutrients free of animal components which can be produced from sunlight and carbon dioxide.

In addition, a life cycle assessment of cultured meat compared to traditionally produced meat was recently published. It shows that the environmental benefits of cultured meat are very large (see attached fact sheet). For example, compared to the rearing of cattle, cultured meat would entail dramatic reductions of greenhouse gas emissions, land use and water use.

Despite these obvious advantages, the area is still very poorly funded. The interdisciplinary group of scientists has decided to form a community to try to attract more funding and to create a faster development in the area of cultured meat. During the workshop last week, they also reached consensus about important issues in the research field. For instance, the nutrients for growing the cells for meat must be produced with renewable energy and without animal products. The best source for this is to use a photosynthetic organism, such as blue-green algae.

Many important decisions remain about how to proceed in the research and development on cultured meat, and the scientists now feel that it is time to spread the discussion outside the research community.

"We want to invite all stakeholders into discussions to tackle these issues and identify in which directions to go," says Julie Gold, associate professor in biological physics at Chalmers, and one of the convenors of the workshop. "To date, there are only limited dedicated research activities in cultured meat. To move forward, research activities have to increase substantially."

The workshop in Sweden engaged an interdisciplinary group of 25 scientists who all have special interest in cultured meat. Some of them have specialties in tissue engineering, stem cells and food technology. Others are environmental scientists, ethicists, social scientists and economists. All of these areas have been discussed during the workshop. The result is encouraging regarding the possibility to actually be able to supply

consumers with cultivated meat in the future, and the scientists have not found any crucial arguments against cultured meat.

"On the contrary, several ethical problems would be solved, especially concerning animal welfare issues," says Stellan Welin, Professor in Biotechnology, Culture and Society, one of the convenors of the workshop.

A European Science Foundation representative took part in the workshop and appreciated the energy from all involved.

"The proposal for sponsoring the exploratory workshop on In vitro meat was enthusiastically accepted by the European Science Foundation, which recognizes in this topic a brand new scientific field, to be deeply explored, given the great potentiality for improving human welfare," says Giovanni Pacini, ESF.

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Story Source:

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

http://www.sciencedaily.com/releases/2011/09/110906085145.htm

Novel Magnetic, Superconducting Material Opens New Possibilities in Electronics

Julie Bert, the paper's first author, and a graduate student at the Stanford Institute for Materials and Energy Science (SIMES), adjusts imaging equipment used to make a startling discovery of two properties that normally can't co-exist. The finding was made by Bert and colleagues at SIMES, a joint institute of the Department of Energy's SLAC National Accelerator Laboratory and Stanford University. They sandwiched two nonmagnetic insulators together and saw magnetic and superconducting regions at the layer where the two materials met. (Credit: Photo by Steve Gladfelter)

ScienceDaily (Sep. 7, 2011) — Scientists have reached a crucial milestone that could lead to a new class of materials with useful electronic properties. In research reported in the Sept. 5 issue of *Nature Physics*, the team sandwiched two nonmagnetic insulators together and discovered a startling result: The layer where the two materials meet has both magnetic and superconducting regions -- two properties that normally can't co-exist.

Technologists have long hoped to find a way to engineer magnetism in this class of materials, called complex oxides, as a first step in developing a potential new form of computing memory for storage and processing.

The discovery, made by researchers at the Stanford Institute for Materials and Energy Science (SIMES), a joint institute of the Department of Energy's SLAC National Accelerator Laboratory and Stanford University, opens "exciting possibilities for engineering new materials and studying the interplay of these normally incompatible states," said Kathryn A. "Kam" Moler, the SLAC/Stanford researcher who led the imaging studies.

A critical next step: Figuring out whether the superconductivity and magnetism co-exist within the material in an uneasy truce, or whether this marks the discovery of an exotic new form of superconductivity that actively interacts with magnetism, said Moler. Superconducting materials, which conduct electricity with no resistance and 100 percent efficiency, normally expel any magnetic field that comes near them.

"Our future measurements will indicate whether they're fighting one another or helping one another," Moler said.

Independently, researchers from the Massachusetts Institute of Technology announced in the same issue of *Nature Physics* that they had confirmed the existence of magnetism at the interface between the two materials using an alternative means of measurement.

In a commentary accompanying both papers, Columbia University physicist Andrew J. Millis, who was not involved in the research, wrote that the work could introduce a new class of materials with "interesting, controllable, novel and perhaps useful collective electronic properties." While this goal is far off, he said, the new findings indicate that "the field has passed a crucial milestone."

SIMES graduate student Julie Bert, the paper's first author, and her colleagues made their observations on a thin film of lanthanum aluminate that had been laid onto a strontium titanate substrate. The structures were grown by researchers working with applied physicist Harold Hwang, who recently moved with his group from the University of Tokyo to join SIMES and now serves as deputy director. The atomic layer where the two oxides meet becomes metallic and allows current to flow with no resistance at temperatures close to absolute zero.

Researchers are starting experiments to see whether anything changes when the material is compressed, or when an electrical field is applied, said Moler. Additional research now must be done, she added, to determine the physical properties that contribute to forming both the magnetism and superconductivity in these oxides.

"Modern technology gives us the amazing ability to grow materials atomic layer by atomic layer," said Moler. "The message of our work is that by doing so we can create new materials with surprising new properties."

The Stanford Institute for Materials and Energy Science, SIMES, is a joint institute of SLAC National Accelerator Laboratory and Stanford University. Research at SIMES is supported in part by the U.S. Department of Energy's Office of Science.

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Story Source:

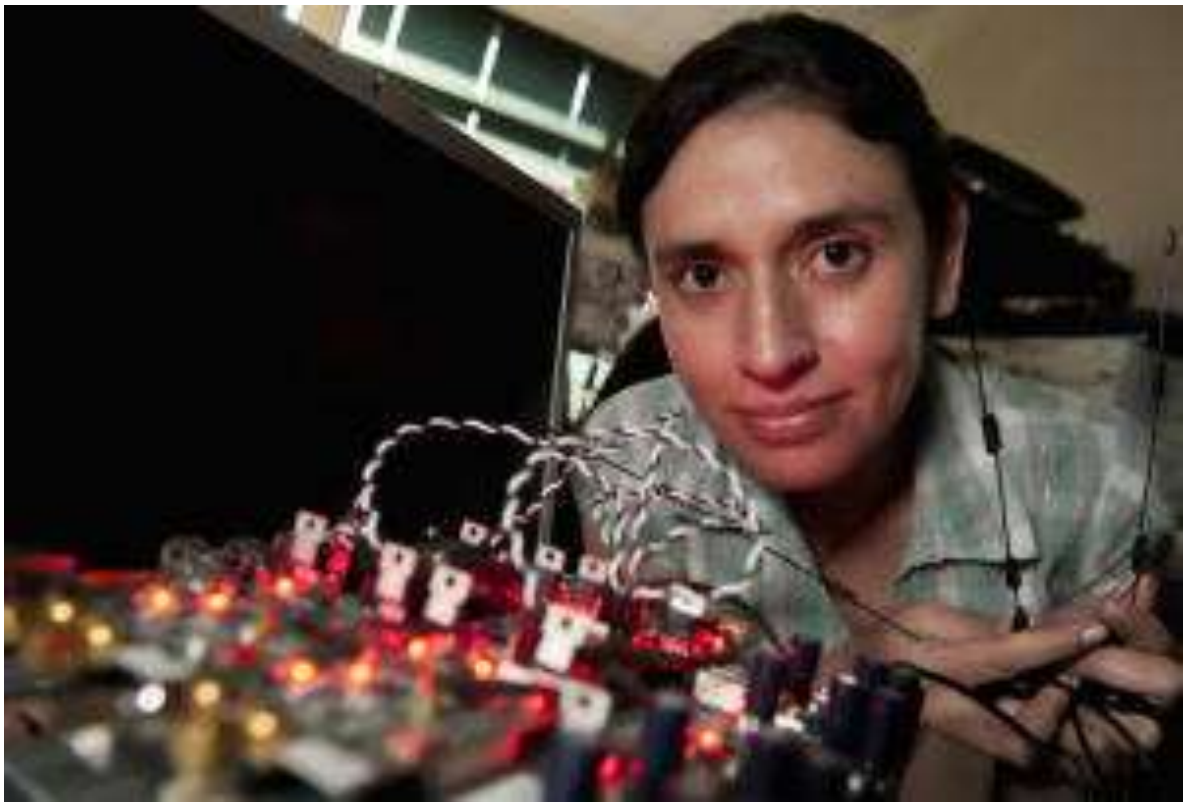
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **DOE/SLAC National Accelerator Laboratory**.

Journal References:

1. Julie A. Bert, Beena Kalisky, Christopher Bell, Minu Kim, Yasuyuki Hikita, Harold Y. Hwang, Kathryn A. Moler. **Direct imaging of the coexistence of ferromagnetism and superconductivity at the LaAlO3/SrTiO3 interface**. *Nature Physics*, 2011; DOI: 10.1038/nphys2079
2. Lu Li, C. Richter, J. Mannhart, R. C. Ashoori. **Coexistence of magnetic order and two-dimensional superconductivity at LaAlO3/SrTiO3 interfaces**. *Nature Physics*, 2011; DOI: 10.1038/nphys2080
3. Andrew J. Millis. **Oxide interfaces: Moment of magnetism**. *Nature Physics*, 2011; DOI: 10.1038/nphys2087

http://www.sciencedaily.com/releases/2011/09/110906121955.htm

Breakthrough Could Double Wireless Capacity With No New Towers



Rice University graduate student Melissa Duarte with a "full-duplex" test device. The technology, which allows wireless devices to "talk" and "listen" to networks on the same frequency, could double throughput on wireless phone networks. (Credit: Jeff Fitlow/Rice University)

ScienceDaily (Sep. 7, 2011) — The days of waiting for smartphones to upload video may be numbered. Rice University engineering researchers have made a breakthrough that could allow wireless phone companies to double throughput on their networks without adding a single cell tower.

Rice's new "full-duplex" technology allows wireless devices like cell phones and electronic tablets to both "talk" and "listen" to wireless cell towers on the same frequency -- something that requires two frequencies today.

"Our solution requires minimal new hardware, both for mobile devices and for networks, which is why we've attracted the attention of just about every wireless company in the world," said Ashutosh Sabharwal, professor of electrical and computer engineering at Rice. "The bigger change will be developing new wireless standards for full-duplex. I expect people may start seeing this when carriers upgrade to 4.5G or 5G networks in just a few years."

In 2010, Sabharwal and Rice colleagues Melissa Duarte and Chris Dick published the first paper showing that full-duplex was possible. That set off a worldwide race to demonstrate that the technology could actually be used in a real network. This summer, Sabharwal and Rice's Achaleshwar Sahai and Gaurav Patel set new performance records with a real-time demo of the technology that produced signal quality at least 10 times better than any previously published result.

"We showed that our approach could support higher throughput and better link reliability than anything else that's been demonstrated, which is a plus for wireless carriers," Sabharwal said. "On the device side, we've shown that we can add full duplex as an additional mode on existing hardware. Device makers love this because real estate inside mobile devices is at a premium, and it means they don't have to add new hardware that only supports full duplex."

To explain why full-duplex wireless was long thought impossible for wireless networks, Sabharwal uses the analogy of two people standing far apart inside an otherwise empty arena. If each shouts to the other at the same time, neither can hear what the other is saying. The easy solution is to have only one person speak at a time, and that's what happens on two-way radios where only one person may speak at a given time. Cell phones achieve two-way communications by using two different frequencies to send and listen.

Rice's team overcame the full-duplex hurdle by employing an extra antenna and some computing tricks. In the shouting analogy, the result is that the shouter cannot hear himself, and therefore hears the only other sound in the arena -- the person shouting from far away.

"We send two signals such that they cancel each other at the receiving antenna -- the device ears," Sabharwal said. "The canceling effect is purely local, so the other node can still hear what we're sending."

He said the cancellation idea is relatively simple in theory and had been proposed some time ago. But no one had figured a way to implement the idea at low cost and without requiring complex new radio hardware.

"We repurposed antenna technology called MIMO, which are common in today's devices," Sabharwal said. "MIMO stands for 'multiple-input multiple-output' and it uses several antennas to improve overall performance. We took advantage of the multiple antennas for our full-duplex scheme, which is the main reason why all wireless carriers are very comfortable with our technology."

Sabharwal said Rice is planning to roll its full-duplex innovations into its "wireless open-access research platform," or WARP. WARP is a collection of programmable processors, transmitters and other gadgets that make it possible for wireless researchers to test new ideas without building new hardware for each test. Sabharwal said adding full-duplex to WARP will allow other researchers to start innovating on top of Rice's breakthrough.

"There are groups that are already using WARP and our open-source software to compete with us," he said. "This is great because our vision for the WARP project is to enable never-before-possible research and to allow anyone to innovate freely with minimal startup effort."

Sabharwal's team has gone one step further and achieved asynchronous full-duplex too -- that is one wireless node can start receiving a signal while it's in the midst of transmitting. Asynchronous transmission is import for carriers wishing to maximize traffic on their networks, and Rice's team is the first to demonstrate the technology.

"We've also developed a preliminary theory <http://arxiv.org/abs/1107.1276> that explains why our system is working the way that it is," Sabharwal said. "That's also important for carriers and device makers, because engineers aren't likely to implement something like this without a clear understanding of fundamental tradeoffs."

Rice's research has been funded by the National Science Foundation, the Roberto Rocca Education Program and Xilinx Incorporated.

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Story Source:

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

Journal Reference:

1. Achaleshwar Sahai, Gaurav Patel, Ashutosh Sabharwal. **Pushing the limits of Full-duplex: Design and Real-time Implementation**. *arXiv*, 4 Jul 2011 [link]

http://www.sciencedaily.com/releases/2011/09/110906134014.htm

Where Does All Earth's Gold Come From?

Gold. (Credit: © Martin Kreutz / Fotolia)

ScienceDaily (Sep. 7, 2011) — Ultra high precision analyses of some of the oldest rock samples on Earth by researchers at the University of Bristol provides clear evidence that the planet's accessible reserves of precious metals are the result of a bombardment of meteorites more than 200 million years after Earth was formed.

The research is published in *Nature*.

During the formation of Earth, molten iron sank to its centre to make the core. This took with it the vast majority of the planet's precious metals -- such as gold and platinum. In fact, there are enough precious metals in the core to cover the entire surface of Earth with a four-metre thick layer.

The removal of gold to the core should leave the outer portion of Earth bereft of bling. However, precious metals are tens to thousands of times more abundant in Earth's silicate mantle than anticipated. It has previously been argued that this serendipitous over-abundance results from a cataclysmic meteorite shower that hit Earth after the core formed. The full load of meteorite gold was thus added to the mantle alone and not lost to the deep interior.

To test this theory, Dr Matthias Willbold and Professor Tim Elliott of the Bristol Isotope Group in the School of Earth Sciences analysed rocks from Greenland that are nearly four billion years old, collected by Professor Stephen Moorbath of the University of Oxford. These ancient rocks provide a unique window into the composition of our planet shortly after the formation of the core but before the proposed meteorite bombardment.

The researchers determined the tungsten isotopic composition of these rocks. Tungsten (W) is a very rare element (one gram of rock contains only about one ten-millionth of a gram of tungsten) and, like gold and other precious elements, it should have entered the core when it formed. Like most elements, tungsten is composed of several isotopes, atoms with the same chemical characteristics but slightly different masses. Isotopes provide robust fingerprints of the origin of material and the addition of meteorites to Earth would leave a diagnostic mark on its W isotope composition.

Dr Willbold observed a 15 parts per million decrease in the relative abundance of the isotope 182W between the Greenland and modern day rocks. This small but significant change is in excellent agreement with that

required to explain the excess of accessible gold on Earth as the fortunate by-product of meteorite bombardment.

Dr Willbold said: "Extracting tungsten from the rock samples and analysing its isotopic composition to the precision required was extremely demanding given the small amount of tungsten available in rocks. In fact, we are the first laboratory world-wide that has successfully made such high-quality measurements."

The impacting meteorites were stirred into Earth's mantle by gigantic convection processes. A tantalising target for future work is to study how long this process took. Subsequently, geological processes formed the continents and concentrated the precious metals (and tungsten) in ore deposits which are mined today.

Dr Willbold continued: "Our work shows that most of the precious metals on which our economies and many key industrial processes are based have been added to our planet by lucky coincidence when the Earth was hit by about 20 billion billion tonnes of asteroidal material."

This research was funded by the Natural Environment Research Council (NERC), the Science and Technology Facilities Council (STFC) and the Deutsche Forschungsgemeinschaft (DFG).

*Recommend this story on **Facebook**, **Twitter**, and **Google +1**:*

Story Source:

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

Journal Reference:

1. Matthias Willbold, Tim Elliott, Stephen Moorbath. **The tungsten isotopic composition of the Earth's mantle before the terminal bombardment**. *Nature*, 2011; 477 (7363): 195 DOI: 10.1038/nature10399

http://www.sciencedaily.com/releases/2011/09/110907132044.htm

Neurosurgeons Use Adult Stem Cells to Grow Neck Vertebrae

Dr. Kee Kim and team in surgery. (Credit: Image courtesy of University of California - Davis Health System / © UC Regents)

ScienceDaily (Sep. 6, 2011) — Neurosurgery researchers at UC Davis Health System have used a new, leading-edge stem cell therapy to promote the growth of bone tissue following the removal of cervical discs -- the cushions between the bones in the neck -- to relieve chronic, debilitating pain.

The procedure was performed by associate professors of neurosurgery Kee Kim and Rudolph Schrot. It used bone marrow-derived adult stem cells to promote the growth of the bone tissue essential for spinal fusion following surgery, as part of a nationwide, multicenter clinical trial of the therapy.

Removal of the cervical disc relieves pain by eliminating friction between the vertebrae and/or nerve compression. Spinal fusion is used following surgery for degenerative disc disease, where the cushioning cartilage has worn away, leaving bone to rub against bone and herniated discs, where the discs pinch or compress nerves.

"We hope that this investigational procedure eventually will help those who undergo spinal fusion in the back as well as in the neck," said Kim, who also is chief of spinal neurosurgery at UC Davis. "And the knowledge gained about stem cells also will be applied in the near future to treat without surgery those suffering from back pain."

Millions of Americans are affected by spine diseases, with approximately 40 percent of all spinal fusion surgery performed for cervical spinal fusion. Some 230,000 patients are candidates for spinal fusion, with the numbers of potential patients increasing by 2 to 3 percent each year as the nation's population ages.

"This is an exciting clinical trial to test the ability of the bone-forming stem cells from healthy donors to help patients with spinal disease," said Jan Nolta, director of the UC Davis Institute for Regenerative Cures.

"For the past 50 years, bone marrow-derived stem cells have been used to rebuild patients' blood-forming systems. We know that subsets of stem cells from the marrow also can robustly build bone. Their use now to promote vertebral fusion is a new and extremely promising area of clinical study," she said.

The stem cell procedure at UC Davis took place early in August. The patient was a 53-year-old male from the Sacramento region with degenerative disc disease.

In the surgery, called an anterior cervical discectomy, a cervical disc or multiple discs are removed via an incision in the front of the neck. The investigational stem cell therapy then is applied to promote fusion of the vertebrae across the space created by the disc removal.

The stem cells are derived from a healthy single adult donor's bone marrow, and thus are very homogenous, Kim said. They are grown in culture to high concentration with minimal chance for rejection by the recipient, he said.

Adequate spinal fusion fails to occur in 8 to 35 percent or more of patients, and persistent pain occurs in up to 60 percent of patients with fusion failure, which often necessitates additional surgery.

"A lack of effective new bone growth after spine fusion surgery can be a significant problem, especially in surgeries involving multiple spinal segments," said Schrot, co-principal investigator for the study. "This new technology may help patients grow new bone, and it avoids harvesting a bone graft from the patient's own hip or using bone from a deceased donor."

Current methods of promoting spinal fusion include implanting bone tissue from the patient's hip or a cadaver to encourage bone regrowth as well as implanting bone growth-inducing proteins. However, the Food and Drug Administration has not approved the use of bone morphogenetic proteins for cervical spinal fusion. Their use has been associated with life-threatening complications, particularly in the neck.

The leading-edge stem cell procedure is part of a prospective, randomized, single-blinded controlled study to evaluate the safety and preliminary efficacy of an investigational therapy: modified bone marrow-derived stem cells combined with the use of a delivery device as an alternative to promote and maintain spinal fusion.

The study includes 10 investigational centers nationwide. The UC Davis Department of Neurological Surgery anticipates enrolling up to 10 study participants who will be treated with the stem cell therapy and followed for 36 months after their surgeries. A total of 24 participants will be enrolled nationwide.

The study is one of several clinical trials under way in the UC Davis Spine Center and led by Kim. He anticipates launching a clinical trial soon to study the safety of injecting stem cells into disc tissue to repair degenerated discs.

The current study is sponsored by Mesoblast, Ltd., of Melbourne, Australia, which is developing adult universal-donor stem cell products built upon the discovery of adult-derived mesenchymal precursor cells. Kim and Schrot will not be compensated for their participation in the study.

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Story Source:

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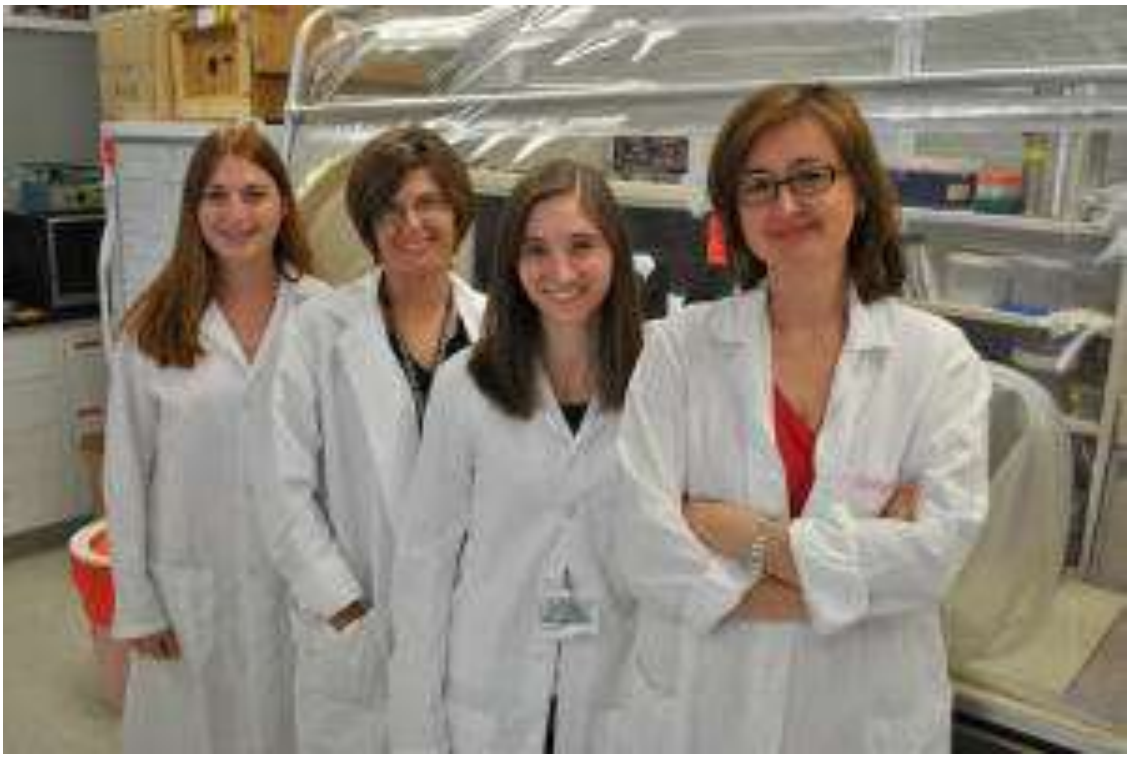
http://www.sciencedaily.com/releases/2011/09/110906152501.htm

Microbes Generate Electricity While Cleaning Up Nuclear Waste



MSU microbiologist Gemma Reguera (right) and her team of researchers have unraveled the mystery of how microbes generate electricity while cleaning up nuclear waste. (Credit: Michael Steger)

ScienceDaily (Sep. 6, 2011) — Researchers at Michigan State University have unraveled the mystery of how microbes generate electricity while cleaning up nuclear waste and other toxic metals.

Details of the process, which can be improved and patented, are published in the current issue of the *Proceedings of the National Academy of Sciences.* The implications could eventually benefit sites forever changed by nuclear contamination, said Gemma Reguera, MSU microbiologist.

"Geobacter bacteria are tiny micro-organisms that can play a major role in cleaning up polluted sites around the world," said Reguera, who is an MSU AgBioResearch scientist. "Uranium contamination can be produced at any step in the production of nuclear fuel, and this process safely prevents its mobility and the hazard for exposure."

The ability of Geobacter to immobilize uranium has been well documented. However, identifying the Geobacters' conductive pili or nanowires as doing the yeoman's share of the work is a new revelation. Nanowires, hair-like appendages found on the outside of Geobacters, are the managers of electrical activity during a cleanup.

"Our findings clearly identify nanowires as being the primary catalyst for uranium reduction," Reguera said. "They are essentially performing nature's version of electroplating with uranium, effectively immobilizing the radioactive material and preventing it from leaching into groundwater."

The nanowires also shield Geobacter and allow the bacteria to thrive in a toxic environment, she added.

Their effectiveness was proven during a cleanup in a uranium mill tailings site in Rifle, Colo. Researchers injected acetate into contaminated groundwater. Since this is Geobacters' preferred food, it stimulated the growth of the Geobacter community already in the soil, which in turn, worked to remove the uranium, Reguera said.

Reguera and her team of researchers were able to genetically engineer a Geobacter strain with enhanced nanowire production. The modified version improved the efficiency of the bacteria's ability to immobilize uranium proportionally to the number of nanowires while subsequently improving its viability as a catalytic cell.

Reguera has filed patents to build on her research, which could lead to the development of microbial fuel cells capable of generating electricity while cleaning up after environmental disasters.

The research team included Dena Cologgi and Allison Speers, MSU graduate students, and Sanela Lampa-Pastirk and Shelly Kelly, post-doctoral researchers. The National Institute of Environmental Health Science and the U.S. Department of Energy funded the study.

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Story Source:

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

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1. Dena L. Cologgi, Sanela Lampa-Pastirk, Allison M. Speers, Shelly D. Kelly, Gemma Reguera. **Extracellular reduction of uranium via Geobacter conductive pili as a protective cellular mechanism**. *Proceedings of the National Academy of Sciences*, 2011; DOI: 10.1073/pnas.1108616108

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Can Cigarette Butts Be Recycled?

A San Diego innovator pays $3 a pound for cigarette butts. But whatever can you recycle them into?

By Matt Skenazy

San Diego's Curtis Baffico shows the original 700-plus cigarette butts he collected in 30 minutes that inspired him to launch the Butt Redemption Value program.

Nearly 2 billion pounds of trash is thrown on the ground every year in the form of cigarette butts — 4.5 trillion cigarette butts, composed largely of filters made from cellulose acetate, a non-biodegradable plastic. But what if all these cigarette butts had a value? What if you could trade them in for cash? Would they then disappear from streets, beaches and parks?

Curtis Baffico, a San Diego stock trader who moonlights as an environmentalist, asked himself these questions and decided to create a recycling system to try to answer them. Baffico raises money on his website, Ripplelife.org, then pays out a "Butt Redemption Value" of $3/pound for whatever cigarette ends people collect and turn in at monthly collection events.

It takes roughly 1,500 cigarette butts to add up to a pound, Baffico says, and he admits that $3 isn't a lot of compensation for the effort required to pick them up. Still, at the first event, held in January in San Diego's Pacific Beach, Baffico and other volunteers collected 11,250 cigarette butts. A second event netted 26,000.

Baffico isn't the first person to attempt to put a value on cigarette butts. In the last few years, legislators in Maine and New York have considered bills that would require some form of butt deposit or return fee. In 2009, San Francisco officials took a slightly different approach by approving a 20 cent fee on every pack of cigarettes, thus charging smokers for the $7.5 million it costs the city annually to clean butts from the streets.

But Baffico is wary of deposit laws and thinks "smokers might feel justified to litter if they already paid the deposit." Others are of a similar mind. In a 2009 paper in the *International Journal of Environmental Research and Public Health*, Tom Novotny, a professor at San Diego State University who specializes in the environmental impact of tobacco use, noted that, "adding a waste tax to cigarettes is a possibility; however, since methods to recycle cigarette butts may be problematic, exactly what this fee would pay for is yet to be determined."

And that has been the consistent problem: Cigarette butts can't be repurposed into more cigarette butts, the way glass bottles can become more bottles. In part that's because cigarette butts are toxic. As cigarettes are smoked, filters trap all sorts of toxic chemicals — nicotine, arsenic, cadmium, vinyl chloride, acetone, mercury and lead — that can leach into surroundings.

So collecting butts is only a first step.

Just the same, Baffico hopes to repurpose every butt he collects, insuring that it never sees a landfill. One of his recycling ideas: Grind up the butts and add them to concrete, replacing fibermesh, an anti-cracking agent that is often added to concrete and usually made from polypropylene. The thought is that the concrete would surround the butts — for instance, in a slab foundation — and keep their toxins from leaching into the environment.

Baffico isn't a lone cigarette-butt innovator. In a 2010 study published in the journal *Industrial & Engineering Chemistry Research*, Chinese researcher Jun Zhao and his colleagues showed that extracts from cigarette butts soaked in water can be used as a rust control compound for a type of steel widely used in the oil industry. A 2009 study found that cigarette butts might be used in the manufacturing of bricks.

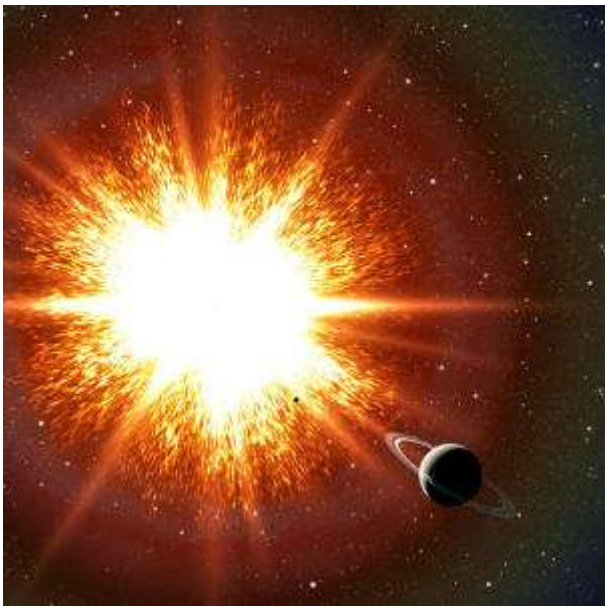
Zhao received substantial press for his study. Environmental groups have lauded Baffico for his Butt Redemption Value program and repurposing goals. But Novotny says that if society is to repurpose cigarette butts, the recycling system has to include tobacco companies. "If there was an effort to get the tobacco industry to take back the filters, like the electronics industry takes back electronic waste," he says, "then it would behoove the industry to find something to do with those filters other than throw them into a landfill."

Actually, though, responsibility for cigarette butts is exactly what the tobacco industry doesn't want. Novotny and Elizabeth Smith, an adjunct professor at the University of California, San Francisco, noted in a study published this year in the *Journal of Tobacco Control* that "the tobacco industry has feared being held responsible for cigarette litter for more than 20 years."

One solution to the used-cigarette problem would be an outright ban on filters. "The cigarette filter is a marketing tool, not a health device," Novotny says. "There really is no health benefit from filters at all." In the absence of governmental action against filters, Novotny conducts more research, and Baffico collects more butts. "This is plastic," Baffico says. "There needs to be a way to convert this into a reusable material."

http://www.miller-mccune.com/environment/can-cigarette-butts-be-recycled-32091/

Milky Way Galaxy Might Hold Thousands of Ticking 'Time Bombs'



New research shows that some old stars known as white dwarfs might be held up by their rapid spins, and when they slow down, they explode as Type Ia supernovae. Thousands of these "time bombs" could be scattered throughout our Galaxy. In this artist's conception, a supernova explosion is about to obliterate an orbiting Saturn-like planet. (Credit: David A. Aguilar (CfA))

ScienceDaily (Sep. 6, 2011) — In the Hollywood blockbuster "Speed," a bomb on a bus is rigged to blow up if the bus slows down below 50 miles per hour. The premise -- slow down and you explode -- makes for a great action movie plot, and also happens to have a cosmic equivalent.

New research shows that some old stars might be held up by their rapid spins, and when they slow down, they explode as supernovae. Thousands of these "time bombs" could be scattered throughout our Galaxy.

"We haven't found one of these 'time bomb' stars yet in the Milky Way, but this research suggests that we've been looking for the wrong signs. Our work points to a new way of searching for supernova precursors," said astrophysicist Rosanne Di Stefano of the Harvard-Smithsonian Center for Astrophysics (CfA).

The specific type of stellar explosion Di Stefano and her colleagues studied is called a Type Ia supernova. It occurs when an old, compact star known as a white dwarf destabilizes.

A white dwarf is a stellar remnant that has ceased nuclear fusion. It typically can weigh up to 1.4 times as much as our Sun -- a figure called the Chandrasekhar mass after the astronomer who first calculated it. Any heavier, and gravity overwhelms the forces supporting the white dwarf, compacting it and igniting runaway nuclear fusion that blows the star apart.

There are two possible ways for a white dwarf to exceed the Chandrasekhar mass and explode as a Type Ia supernova. It can accrete gas from a donor star, or two white dwarfs can collide. Most astronomers favor the first scenario as the more likely explanation. But we would expect to see certain signs if the theory is correct, and we don't for most Type Ia supernovae.

For example, we should detect small amounts of hydrogen and helium gas near the explosion, but we don't. That gas would come from matter that wasn't accreted by the white dwarf, or from the disruption of the companion star in the explosion. Astronomers also have looked for the donor star after the supernova faded from sight, without success.

Di Stefano and her colleagues suggest that white dwarf spin might solve this puzzle. A spin-up/spin-down process would introduce a long delay between the time of accretion and the explosion. As a white dwarf gains mass, it also gains angular momentum, which speeds up its spin. If the white dwarf rotates fast enough, its spin can help support it, allowing it to cross the 1.4-solar-mass barrier and become a super-Chandrasekhar-mass star.

Once accretion stops, the white dwarf will gradually slow down. Eventually, the spin isn't enough to counteract gravity, leading to a Type Ia supernova.

"Our work is new because we show that spin-up and spin-down of the white dwarf have important consequences. Astronomers therefore must take angular momentum of accreting white dwarfs seriously, even though it's very difficult science," explained Di Stefano.

The spin-down process could produce a time delay of up to a billion years between the end of accretion and the supernova explosion. This would allow the companion star to age and evolve into a second white dwarf, and any surrounding material to dissipate.

In our Galaxy, scientists estimate that there are three Type Ia supernovae every thousand years. If a typical super-Chandrasekhar-mass white dwarf takes millions of years to spin down and explode, then calculations suggest that there should be dozens of pre-explosion systems within a few thousand light-years of Earth.

Those supernova precursors will be difficult to detect. However, upcoming wide-field surveys conducted at facilities like Pan-STARRS and the Large Synoptic Survey Telescope should be able to spot them.

"We don't know of any super-Chandrasekhar-mass white dwarfs in the Milky Way yet, but we're looking forward to hunting them out," said co-author Rasmus Voss of Radboud University Nijmegen, The Netherlands. The research appears in the *Astrophysical Journal*.

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1. R. Di Stefano, R. Voss, J. S. W. Claeys. **Spin-up/Spin-down Models for Type Ia Supernovae**. *The Astrophysical Journal*, 2011; 738 (1): L1 DOI: 10.1088/2041-8205/738/1/L1

http://www.sciencedaily.com/releases/2011/09/110906152453.htm

In More Socially Engaging Environment, White Fat Turns to Brown, Mouse Study Suggests

Lab mice. (Credit: iStockphoto)

ScienceDaily (Sep. 6, 2011) — When mice are given a more engaging place to live with greater opportunities for social stimulation, some of their energy-storing white fat is transformed to energy-burning brown fat. As a result, the animals expend more energy and lose weight even as they eat more. The findings reported in the September *Cell Metabolism* point to the powerful effect that animals' social and physical environments can have on their metabolisms.

"I'm still amazed at the degree of fat loss that occurs," says Matthew During of The Ohio State University. "The amount that comes off is far more than you would get with a treadmill."

"After four weeks in the enriched environment, the animals' abdominal fat decreased by fifty percent," added Lei Cao, also of Ohio State.

The standard laboratory mouse lives what might be considered a "couch potato" existence, Cao says. They are kept comfortable with an endless supply of food and water and a few potential playmates. But they don't have much of anything to do.

In the enriched environment, animals live in larger groups of 15 to 20 animals. They have more space as well as wheels to run on, mazes to navigate and toys to play with.

"We often think of stress as a negative thing, but some kinds of stress can be good for your health," Cao says. In fact, she says, the enriched housing is more taxing for the animals as they have to deal with each other and with a more complex environment.

The new study follows on one reported in Cell last year by the same research team showing that more complex housing also has profound and beneficial effects on cancer. The researchers had also shown that an enriched environment leads to improved cerebral health as defined by increased production of new neurons, enhanced learning and memory, and greater resistance of the brain to insults. The key in all cases seemed to be an increase in the brain's production of a growth factor known as brain-derived neurotrophic factor (BDNF).

Cao and During had also noted previously that the mice showed changes in their fat tissue and grew leaner than animals living under standard conditions. They now trace that leaner build to an increase in brown fat.

Fat comes in one of two types: white or brown. White fat is the kind we generally try to keep off as it stores all those extra calories. Brown fat burns energy to generate heat. It is perhaps best known for keeping babies warm, but scientists have now realized that adults do retain active brown fat. We can be made to produce more brown fat through exposure to cold or activation of the sympathetic nervous system. The new study suggests a more engaging environment is another, perhaps more effective path to increasing brown fat.

"It's usually hard to induce the switch from white to brown fat," During says. "It takes months of cold -- you really have to push -- and it doesn't induce brown fat to the same degree as what on the surface appears to be a relatively mild change in physical and social environments."

Animals made to produce more BDNF in their brains also show the increase in brown fat and weight loss observed in those living in an enriched environment.

The new result may offer insight into studies showing a link between loneliness and ill health, Cao says. "Loneliness is a profound factor for cancer and death; it's on par with cigarette smoking," she says. "Social engagement is very important."

Although it isn't yet clear why, the new study shows fat to be one of the organs most responsive to changes in the environment. The findings might therefore have important lessons for us about the causes of the obesity epidemic we now face.

"It's not just a sedentary lifestyle and high calorie foods, but an increasing lack of social engagement," During says, as online networking and social media have replaced more dynamic, face-to-face social interactions.

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http://www.sciencedaily.com/releases/2011/09/110906121242.htm

Couch Potatoes Explained? Missing Key Genes May Be Cause for Lack of Resolve to Exercise, Researchers Find

So-called couch potatoes may be missing key genes, a new mouse study suggests. (Credit: Image courtesy of McMaster University)

ScienceDaily (Sep. 6, 2011) — You may think your lack of resolve to get off the couch to exercise is because you're lazy, but McMaster University researchers have discovered it may be you are missing key genes.

The researchers made their unexpected finding while working with healthy, specially-bred mice, some of which had two genes in muscle essential for exercise removed. The genes control the protein AMP-activated protein kinase (AMPK), an enzyme that is switched on when you exercise.

"Mice love to run," said Gregory Steinberg, associate professor of medicine in the Michael G. DeGroote School of Medicine and Canada Research Chair in Metabolism and Obesity.

"While the normal mice could run for miles, those without the genes in their muscle could only run the same distance as down the hall and back. It was remarkable. The mice looked identical to their brothers or sisters but within seconds we knew which ones had the genes and which one didn't."

The researchers found the mice without the muscle AMPK genes had lower levels of mitochondria and an impaired ability for their muscles to take up glucose while they exercise.

"When you exercise you get more mitochondria growing in your muscle. If you don't exercise, the number of mitochondria goes down. By removing these genes we identified the key regulator of the mitochondria is the enzyme AMPK," said Steinberg.

Thousands of scientists around the world are working on AMPK but the McMaster team is the first to demonstrate its essential role in exercise. Their research appears in the current issue of the *Proceedings of the National Academy of Sciences*.

Steinberg said the findings are important for individuals who find it difficult to exercise, such as the obese, asthmatics and people in wheelchairs. Their inability to exercise may lead to other complications such as diabetes and heart disease.

The study, he thinks, has a message for couch potatoes. "As we remove activity from our lives due to emerging technology, the base level of fitness in the population is going down and that is reducing the mitochondria in people's muscles. This in turn makes it so much harder for people to start exercising."

Steinberg himself runs or bikes to work. "It is the only way that I can manage to make sure I stay fit."

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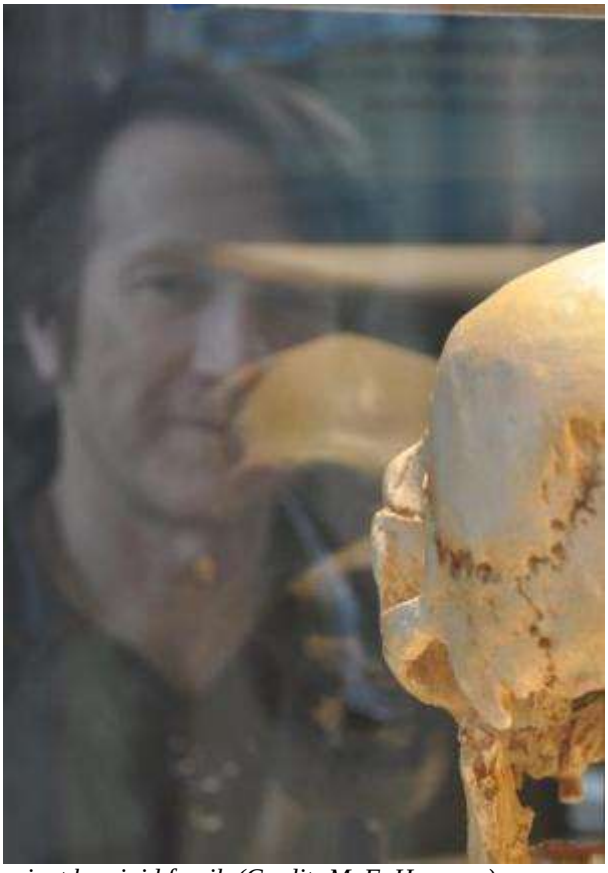
Ancient Humans Were Mixing It Up: Anatomically Modern Humans Interbred With More Archaic Hominin Forms While in Africa



University of Arizona's Michael F. Hammer with an ancient hominid fossil. (Credit: M. F. Hammer)

ScienceDaily (Sep. 6, 2011) — It is now widely accepted that the species Homo sapiens originated in Africa and eventually spread throughout the world. But did those early humans interbreed with more ancestral forms of the genus Homo, for example Homo erectus, the "upright walking man," Homo habilis, -- the "tool-using man" or Homo neanderthalensis, the first artists of cave-painting fame?

Direct studies of ancient DNA from Neanderthal bones suggest interbreeding did occur after anatomically modern humans had migrated from their evolutionary cradle in Africa to the cooler climates of Eurasia, but what had happened in Africa remained a mystery -- until now.

In a paper published in the *Proceedings of the National Academy of Sciences* (PNAS), a team led by Michael Hammer, an associate professor and research scientist with the the University of Arizona's Arizona Research Labs, provides evidence that anatomically modern humans were not so unique that they remained separate.

"We found evidence for hybridization between modern humans and archaic forms in Africa. It looks like our lineage has always exchanged genes with their more morphologically diverged neighbors," said Hammer, who also holds appointments in the UA's department ofecology and evolutionary biology, the school of anthropology, the BIO5 Institute and the Arizona Cancer Center.

Hammer added that recent advances in molecular biology have made it possible to extract DNA from fossils tens of thousands of years old and compare it to that of modern counterparts.

However, "We don't have fossil DNA from Africa to compare with ours," he said. "Neanderthals lived in colder climates, but the climate in more tropical areas make it very tough for DNA to survive that long, so recovering usable samples from fossil specimens is extremely difficult if not impossible."

"Our work is different from the research that led to the breakthroughs in Neanderthal genetics," he explained. "We couldn't look directly for ancient DNA that is 40,000 years old and make a direct comparison."

To get past this hindrance, Hammer's team followed a computational and statistical approach.

"Instead, we looked at DNA from modern humans belonging to African populations and searched for unusual regions in the genome."

Because nobody knows the DNA sequences of those now extinct archaic forms, Hammer's team first had to figure out what features of modern DNA might represent fragments that were brought in from archaic forms.

"What we do know is that the sequences of those forms, even the Neanderthals, are not that different from modern humans," he said. "They have certain characteristics that make them different from modern DNA."

The researchers used simulations to predict what ancient DNA sequences would look like had they survived within the DNA of our own cells.

"You could say we simulated interbreeding and exchange of genetic material in silico," Hammer said. "We can simulate a model of hybridization between anatomically modern humans and some archaic form. In that sense, we simulate history so that we can see what we would expect the pattern to look like if it did occur."

According to Hammer, the first signs of anatomically modern features appeared about 200,000 years ago.

First, the team sequenced vast regions of human genomes from samples taken from six different populations living in Africa today and tried to match up their sequences with what they expected those sequences to look like in archaic forms. The researchers focused on non-coding regions of the genome, stretches of DNA that do not contain genes, which serve as the blueprints for proteins.

"Then we asked ourselves what does the general pattern of variation look like in the DNA that we sequenced in those African populations, and we started to look at regions that looked unusual," Hammer said. "We discovered three different genetic regions fit the criteria for being archaic DNA still present in the genomes of sub-Saharan Africans. Interestingly, this signature was strongest in populations from central Africa."

The scientists applied several criteria to tag a DNA sequence as archaic. For example, if a DNA sequence differed radically from the ones found in a modern population, it was likely to be ancient in origin. Another telltale sign is how far it extends along a chromosome. If an unusual piece is found to stretch a long portion of a chromosome, it is an indication of being brought into the population relatively recently.

"We are talking about something that happened between 20,000 and 60,000 years ago -- not that long ago in the scheme of things," Hammer said. "If interbreeding occurs, it's going to bring in a whole chromosome, and over time, recombination events will chop the chromosome down to smaller pieces. And those pieces will now be found as short, unusual fragments. By looking at how long they are we can get an estimate of how far back the interbreeding event happened."

Hammer said that even though the archaic DNA sequences account for only two or three percent of what is found in modern humans, that doesn't mean the interbreeding wasn't more extensive.

"It could be that this represents what's left of a more extensive archaic genetic content today. Many of the sequences we looked for would be expected to be lost over time. Unless they provide a distinct evolutionary advantage, there is nothing keeping them in the population and they drift out."

In a next step, Hammer's team wants to look for ancient DNA regions that conferred some selective advantage to the anatomically modern humans once they acquired them.

"We think there were probably thousands of interbreeding events," Hammer said. "It happened relatively extensively and regularly."

"Anatomically modern humans were not so unique that they remained separate," he added. "They have always exchanged genes with their more morphologically diverged neighbors. This is quite common in nature, and it turns out we're not so unusual after all."

The paper, "Genetic Evidence for Archaic Admixture in Africa," was co-authored by August Woerner from the UA's ARL Division of Biotechnology, Fernando Mendez from the UA's department of ecology and evolutionary biology, Joseph Watkins from the UA's Mathematics Department and Jeffrey Wall from the Institute for Human Genetics at the University of California San Francisco.

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http://www.sciencedaily.com/releases/2011/09/110905160918.htm

Rescuing the Rural Edge — It Takes a Village

New planning initiatives protect agriculture and nature, while still accommodating growth.

By Jonathan Lerner

A grape field butts up against a housing tract in Fresno, Calif. Farmland is being eaten up in the northwest are of the city but many homes remain unsold. (Gary "Kaz" Kazanjian)

Where suburbia merges into countryside typically looks peaceful enough, with lawns giving way to forests and fields. But in most places, this is a zone of conflict and dysfunction. The steady loss of farmland and natural habitat to sprawl-pattern development endangers food supplies and other resources, as well as the health, wealth and survival prospects of individuals and even whole communities.

Take California's fifth-largest city, Fresno, located in one of the most productive areas on Earth, the San Joaquin Valley. Agriculture is the principal industry in Fresno County — generating more than $5 billion annually — with table grapes, stone fruits, nuts, vegetables, cotton, dairy and livestock among its important products.

Vast, industrialized agribusiness operations may be the dominant image of California farming, and they're present here. But the majority of Fresno County's farms are relatively small and family-run, and nearly half of those are minority-operated. In 2007, more than half the county's farms had gross sales of less than $50,000.

But Fresno could be the poster child for sprawl as easily as bigger exemplars, such as Atlanta or Los Angeles. Efforts to create growth boundaries and encourage compact land-use practices have not prevented new developments from leapfrogging into the countryside.

It's a place "built on flat land, with no real limits to growth in a lot of directions," says the city's planning director, John Dugan, "like almost every place you could see in the Midwest or South." He points to "new malls approved in the last couple of years — million-plus, 2 million-plus-square-foot malls eight, 10 miles from the central city," and plans for "a 3,000-unit retirement community plunked out in the middle of nowhere," 10 miles beyond the city limits.

Never mind, for the moment, the aesthetics of this development pattern; the momentum of suburban expansion is also a threat to Fresno County agriculture. Between 1990 and 2004, more than 21,000 acres in Fresno County became urbanized. About three-quarters of that new development consumed agricultural land, more than half of which was considered high-quality. The American Farmland Trust has estimated that if conventional growth patterns continue, by 2040 the county could lose another 135,000 acres of farmland, out of a total of about 2.25 million acres.

But a new approach to regional planning could help turn that pattern around in Fresno and elsewhere. At scales ranging from a few hundred to many thousands of acres, the approach aims to protect unspoiled and working landscapes while allowing development to accommodate expanding populations.

A paradox?

An impossibility?

Not if that development takes a form radically different from conventional suburban sprawl.

Forget large-lot, single-family, cul-de-sac subdivisions accessed by traffic arteries lined with fast-food and big-box outlets. Future development would be densely clustered or channeled into towns and villages on sites less valuable for farming and conservation or where infrastructure already exists. Besides homes, these growth centers would include shops, workplaces, schools, pedestrian amenities and transit.

This kind of development, known as new urbanism, is already increasingly familiar. What's new is its integration with efforts to protect working and natural landscapes.

Such a plan now under consideration for Fresno, called SEGA (for Southeast Growth Area), focuses on a 9,000-acre swath along the city's southeastern edge. This land, while not currently inside the city limits, lies within Fresno's defined "sphere of influence" and so is destined for annexation and development. Small farms occupy much of this area, though subdivisions have begun to encroach; there are about 700 single-family homes within the boundaries, nearly all recently built. To the east, in unincorporated Fresno County, the land remains overwhelmingly agricultural.

The plan would apply the principles of new urbanism at much greater intensity. There would be as many as 20 predominantly residential neighborhoods, each centered on an elementary school and some "convenience" retail, such as dry cleaners, coffee shops or neighborhood groceries.

Seven larger "community centers" would have denser housing and more significant commercial and job presence, while a downtown-like "regional center," served by regional rapid transit, would be the primary employment, shopping and cultural destination. Throughout SEGA, parks, bike trails and conservation areas, transit routes and narrow streets with sidewalks would all encourage physical activity and discourage automobile use.

All together, a mix of single- and multi-family housing types would accommodate 45,000 households. By contrast, if the 9,000 acres were developed under existing regulations and in typical suburban mode, it could eventually have about 18,000 homes.

Even under SEGA, that's an average of five units per acre — still pretty spacious, compared to many cities — in place of the two per acre deliverable by conventional development. The plan also calculates that there would be 37,000 jobs within the growth area by the time it is built out.

Small-scale agriculture is an important dimension of the plan. Community and school gardens and orchards would be located throughout. Small commercial farming operations, along with much of the land destined for conservation, would be concentrated along the eastern edge, providing a transition and buffer between the newly urbanized SEGA and the overwhelmingly agricultural countryside beyond it.

Fully 20 percent of Fresno's expected population growth between now and 2050 could be absorbed into SEGA, with a commensurate easing of the pressure to convert outlying farmland into suburbs. To provide for the same number of new households using conventional suburban development patterns would sacrifice an additional 9,300 acres of farmland beyond the growth area's 9,000.

More than 3,000 Fresno citizens participated enthusiastically in public meetings when the concept was first being discussed, and "the City Council, at the time, funded the plan so far, based a lot on that public input," Dugan says. Now it's in draft form but meeting some resistance.

Two members of the seven-member Fresno City Council, with the support of a third, issued a report in February seeking to halt the project. It led to a contentious council meeting shortly after, but no action has been taken since.

With the economic downturn slowing growth, some now feel it may be too visionary — looking too far into the future — and will require too much public investment to be sustainable. There are developers who are simply resistant to changing how they build.

Plus, Fresno "has been so deeply impacted by fragmented infrastructure and fragmented development," says Joe DiStefano of Calthorpe Associates, the plan's principal author, "sidewalks that just end, no cohesive infrastructure investment program to drive development in any kind of organized way, that it's left so much bad feeling about development in general."

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The SEGA plan is intriguing because of its ambitious scale and fine-grained detail, and because Fresno County lies within such an important agricultural region. But it's only one of many plans that address the suburban-rural edge with the goal of protecting land while permitting growth.

Though the particulars differ, they all share the basic approach of building compact towns or villages as a way to avoid consuming undeveloped land. This kind of planning is equally applicable to protecting places where agriculture is not present, such as desert or wetland environments. But it directly addresses today's concerns over the sources and security of our food. These new villages would offer ready markets for adjacent farmers — especially small producers. Residents' access to fresh food, and involvement in producing it, would be further encouraged by designing space for gardens, small farming operations and farm markets.

Many greenfield residential projects coming from new-urbanist architects and builders now incorporate, at the least, community gardens and a small farm. Buyers pay a premium to live in these communities for many reasons. Among those are worries about the environmental and health costs of industrialized agriculture, and

the desire for — and perhaps, too, the romance of — an intimate relationship with the people and land that produce their food.

Some such plans are for individual subdivisions of just a few hundred acres. At Hampstead, a development on former farmland outside Montgomery, Ala., nearly a third of the 416 acres will remain unbuilt greenspace. There are garden plots for residents' use. A nonprofit associated with the community operates a 3-acre farm that supplies a natural-foods store and several restaurants, runs food- and farming-oriented workshops for schools and community groups, and has established a second farming plot in a downtown redevelopment area. Hampstead might not directly contribute to the preservation of the agricultural land beyond its perimeter, but it does begin to address the desire for healthful, locally sourced food.

A more intense concept for an agriculturally oriented subdivision is The Farmstead, planned for a site near Charlotte, N.C. It is designed to accommodate 275 units of housing on 128 acres. Fifty-two acres will remain permanently undeveloped, including an 11.5-acre commercial farm. In addition to the usual community garden plots, many larger homesites there are conceived as "steward farms" that owners could either work themselves or contract with the commercial farmer to manage.

On a larger scale still is a plan for 2,300 acres at Pingree Grove, about 50 miles northwest of Chicago, where conventional suburbanization exploded the population from fewer than 150 in 2000 to more than 4,000 today.

"We decided to tap into their agricultural heritage," says Brian Wright of the Town Planning and Urban Design Collaborative, which devised a scheme to manage growth while protecting — and leveraging — the rural character of the place. The plan includes a working farm, community garden spaces (including vegetable gardens enclosed within courtyard apartment blocks) and window-box gardens. "Even in the main town square, we've got some garden plots," he says. The plan calls for a farmers market, a sustainable-agriculture education center, and inns and farm-to-table restaurants that can attract weekend and daytripping agritourists.

Included is a proposal to create the municipal position of "town farmer" to manage the working farm and community garden programs. About 700 residential units will be built along with commercial and office space. Efforts are being made to restore service at an unused local stop on an existing regional rail line connecting Pingree Grove to Chicago.

"It has a real economic development focus," Wright says. "It's overtly agricultural in nature, in the process creating their new downtown."

An inversion of that idea is the plan adopted for the Middle Green Valley of Solano County, Calif. It will locate several dense, mixed-use new neighborhoods in a now mostly fallow 1,400-acre area. The idea is to get agriculture going again and interdict the sprawl closing in from three directions. A nonprofit conservancy, partially funded by a levy on the sale of each building lot, will be established to encourage, or perhaps manage, farming operations and to steward conservation land. It will also play an educational and community-building role, according to its mission statement, "fostering an appreciation and understanding of the environment, the connection to regional food systems and a healthy lifestyle."

Sibella Kraus, president of the SAGE Center, a think tank focused on urban-edge agriculture, consulted on the plan. "We often just look at agriculture as the green land, but sometimes," she says, "agriculture really could be better defined as a rural town and the lands around it. The vitality of the agricultural lands is very much interdependent with that little town. Often, what [farmers] need are things that need to be in a town, like housing for workers, a distribution site and amenities for agritourism."

Many of these new plans mention locating other kinds of farm support in the new towns, such as equipment-sharing co-ops, produce-processing facilities and agricultural research stations.

Curiously, despite how much of this kind of planning is going on, there's no commonly accepted name for it.

"Conservation planning" and "agricultural planning" are already in use for protecting, respectively, natural lands and farmlands — but many use those terms to mean conservation that excludes development all together. The concept of the "urban growth boundary," which forces dense development and limits sprawl, is related to these plans but doesn't, by itself, promote agriculture and conservation. The buzz phrases "smart growth" and "sustainable development" are too general, and perhaps debased, to be useful. Some new-urbanists say "agricultural urbanism" or "agrarian urbanism." Quint Redmond, whose TSR Group master-planned The Farmstead, calls his projects "agriburbia." Kraus likes "new ruralism."

Whatever it's called, new-urbanist thinking is essential because it provides the tools for creating places for growth that are not only dense but desirable. (Desirability equals price. It is well documented that real estate values are higher in places that have the attributes of new-urbanist planning compared to properties that are otherwise similar.)

Central among those new-urbanist tools is the "form-based code." Like other kinds of building codes, form-based codes regulate the appearance and shape of the built environment. But where preservation codes, for example, might restrict anachronistic alterations to historic facades, and conventional zoning codes prevent residential and commercial activities in the same place, form-based codes establish the spatial and visual coherence that gives anywhere a sense of being somewhere and can make that somewhere feel good to be in. They address, for example, the dimensions of streets and sidewalks, the relationships between building facades and the public realm, and the height and massing of buildings. How wide will streets be? Will there be on-street parking? A planted strip between street and sidewalk? Garages facing the street, or only accessed via back alleys? Can buildings be taller at major intersections than on secondary streets?

These codes are based on relationships distilled from the analysis of historic cities and are often influenced as well by the architectural and town-building traditions of the locale for which they are devised. This is the underpinning of new-urbanist planning — at least as important in new urbanism's effectiveness, if perhaps less obviously so, as any architectural style. Most of these new agriculturally oriented plans call for form-based coding. At the same time, this agriculturally oriented approach to planning the suburban edge signals a maturation of new urbanism itself. And it may just finally lay to rest a persistent criticism.

New-urbanists are responsible for many infill projects in urban areas. These include redevelopment of dozens of moribund small-town downtowns and the concept for the federal HOPE VI program. HOPE VI has replaced more than 100,000 units of distressed and dangerous public housing across the country with mixed-use, mixed-income neighborhoods providing a greater number of units, half of them accessible to very-low-income households. Still, the highest profile new-urbanist developments have been in resort and exurban greenfield locations. And they are expensive.

So the movement has been derided for creating isolated bubbles of walkability, urbanist in form and even urbane in feel but disconnected from any "urb" — elite oases where residents can stroll out to a concert on the village green, but still must (or choose to) come and go by car like suburbanites everywhere. However, new developments at the urban-rural interface, integrated into and energizing of adjacent working landscapes, can hardly be called isolated bubbles.

The success of these plans will depend not only on their urban design and agricultural connections. For one thing, it remains to be seen whether there is a truly mass market for new-urbanist living. How tenacious is the common desire for a stand-alone house? In a place such as Fresno, where it's blisteringly hot in summer, and chilly and foggy in winter, how willing will people really be to walk and use transit?

These plans must also actually protect land for conservation and farming. Accommodating more people on less land reduces the pressure. But by itself, that does not prevent building in the adjacent countryside. Under

U.S. law, ownership of land carries with it the right to develop. So what can stop the farmer across the road from your appealing, densely built, mixed-use village from parking his tractor, subdividing his acreage, putting up McMansions on 5-acre lots and harvesting money instead of crops?

Many of these plans rely on a legal mechanism called transfer of development rights (TDR). Simply put, under a transfer program devised to protect rural land, an area facing potential development is divided into "sending areas," meant to remain unbuilt, and "receiving areas," designated for growth. The distinction is determined based on the relative quality of a given plot of land for agricultural use; the configuration of wetlands and other natural features; the presence of historic sites deserving of preservation; and where settlement and infrastructure, such as roads and water systems, already exist. The sending areas will be relatively large, the receiving areas compact.

Suppose an area under consideration is 2,000 acres, and its current zoning allows one dwelling unit per acre. A landowner in a sending area who owns 500 acres can sell the right to develop 500 units, or 500 transfer "credits." His acreage is placed under a permanent easement; an existing home can remain, and the land can be farmed or held in conservation, or even abandoned, but it cannot be further developed.

The landowner benefits by getting some cash based on the land's market value but without carving it up. Who buys these credits? Usually a developer — or a nonprofit, municipality or specially created land bank, which would then sell them to a developer — who has the right to build those 500 units in a receiving area.

The same total number of dwellings — 2,000, in this hypothetical example — might be built, but they would be concentrated rather than spread out. Some transfer programs add a bonus, so that the total acreage might absorb an even greater population than it could under existing zoning, while still preserving land.

While versions of TDR are common, they're not without problems. One of those is establishing a market value for the rights, since all the open acreage is not necessarily equally useful for agricultural or conventional development. Another is the touchy matter of making the transfers mandatory. The SEGA plan, for one, which has vocal opposition, only goes as far as saying that some such mechanism will have to be elaborated.

"The only way SEGA can be successful is to be either a TDR scheme or have some kind of transfer of development benefits," DiStefano says, "to balance the windfalls that occur."

Keith Bergthold, Fresno's assistant director of planning and development, calls SEGA "a paradigm change for the valley and Fresno. But every time we have implementation discussions, people pick on that, rather than getting into this concept of urban form. … If we can get this concept, then we can give them a menu of 'hows.'"

The transfer of development rights certainly can work. A 1997 master plan for Chesterfield Township, N.J., with an area of about 14,000 acres, established a voluntary TDR program and defined sending and receiving areas. Nearly 15 years later, development rights to some 7,000 acres have been transferred. Newly built Old York Village, which will eventually have about 1,200 homes and was sited to make use of existing sewer infrastructure, is well on the way to completion. It has a school, retail and office presence, a tight street grid, and ample parks and trails. Predating today's concern for local and sustainable agriculture, it includes no organic farm or community gardens.

Still, since 1997, "not one conventional development has been approved" for the township, which remains predominantly rural, says Lisa Specca of Clarke Caton Hintz, the village's planners.

It is probably no accident that the grandest of all these planning initiatives are for places where extinguishing landowners' development rights is not an issue. One of those, the East Edisto Smart Code, covers 78,000

acres near Charleston, S.C. But the tract has a single owner, forest products giant MeadWestvaco, which devised the plan because it sees a future there of both population growth and diminishing forestry.

Another, the Growth Plan for the Greater Golden Horseshoe, applies to 7.6 million acres in an arc encircling metropolitan Toronto. But under Canadian law, landowners do not automatically have the right to develop. There, development can occur only where allowed by government. That is the typical situation in Europe, too, where similarly scaled regional planning to keep growth compact and preserve agriculture is commonplace.

Given the inevitability of population growth, plans like that for Fresno's SEGA are essential for preserving unbuilt and working landscapes at the suburban edge. But plans only go so far, and no one is more aware of that than the people drawing them up.

Last June's Congress for the New Urbanism focused on integrating agriculture with development, and the questions ranged far beyond the usual concerns of architects and planners. What about public acceptance? People may love fresh, local food but object to living downwind from the noise of tractors and the smell of manure, or reject sacrificing lawns and ornamental gardens for unaesthetic vegetable plots. What about the paucity of local and regional food processing and distribution systems, which once existed but were lost in the shift to centralized industrial agriculture? What about colder or drier regions, where conditions limit production?

Even in bountiful places, how much of a population's food supply can realistically be locally sourced? The current planning initiatives don't have all the answers. But they can preserve the farmland. Without that, such questions are pointless.

http://www.miller-mccune.com/environment/rescuing-the-rural-edge-%E2%80%94-it-takes-a-village-34304/?utm_source=Newsletter177&utm_medium=email&utm_content=0907&utm_campaign=newsletters

Work-Life Balance Benefits Low-Wage Workers, Employers

A growing body of research reveals myriad benefits — for employers and employees alike — when company policies promoting work-life balance are offered to low-wage workers.

By David Villano

A handful of researchers around the country are exploring one of the most overlooked areas of labor policy: work-life balance at the bottom end of the pay scale. (Illustration by Mario Wagner)

In late summer, with the back-to-school shopping season in full swing, a small group of clothing retailers in Chicago will challenge convention by offering their low-wage, mostly part-time workers a list of perks normally reserved for management: flexible hours, time off when needed, and a locked-in schedule of shifts that allows workers to plan a full month, rather than a few days, in advance.

If researchers overseeing the experiment are correct, higher worker satisfaction at those stores will boost employee morale, retention rates and productivity, pushing labor costs down and revenues up. Meanwhile, those workers will report reduced stress, better physical and mental heath, and stronger relationships with family and friends.

"It's really a win-win," says Susan Lambert, an associate professor at the University of Chicago's School of Social Service Administration, who will compare employee turnover at the Chicago retailers to others in the area with traditional, less family-friendly work policies. "But few firms are willing to make the change. They still view low-level jobs as a cost to be controlled rather than an opportunity to cultivate a workforce."

Lambert is among a handful of researchers around the country exploring one of the most overlooked areas of labor policy: work-life balance at the bottom end of the pay scale.

The kinds of flexible workplace benefits the professional class often take for granted — maternity and sick leave, time off for family emergencies, control over their work schedules, telecommuting — rarely trickle down the pay ladder. Yet, studies show that workers at or near minimum wage are most in need of such benefits. The working poor are more likely to hold down more than one job, have greater health care needs, are more likely to be single parents and caregivers, and report greater difficulty commuting to their jobs.

"We've been talking about work-life balance for a long time, but we haven't been talking about who has been excluded from these kinds of arrangements," Lambert says from her Chicago office, noting a mild pang of guilt for the flexible workplace benefits she enjoys. "The people who really need flexible arrangements often don't have them."

While much attention in recent years has focused on minimum wage and so-called living-wage legislation, experts argue that for many low-wage workers, actual wages are less important than the schedule of work.

"There's a reason why so many low-paying jobs have high turnover rates, and it's not because people don't want to work," argues Lambert, who says studies show that about half of all part-time employees would prefer more work hours each week, and of those, 80 percent would prefer full-time employment. And yet, two-thirds of the retail stores in one study had employee turnover rates in excess of 80 percent. "People want to work, but they also need to care for sick children, go to the doctor … the kinds of things that shouldn't cost you your job."

Jobs are scarce, even on the low end of the scale, and employers know it. If workers take time off for personal needs, for instance, or they decline a shift, they can be quickly replaced. Many employers within low-paying industries such as retailing, food service and manufacturing trim labor costs by using the "just-in-time" scheduling strategy — cutting worker hours on short notice when work is slow and adding hours quickly when demand improves. The practice wreaks havoc on workers' lives, many of them juggling second jobs, school, child care and other basic family needs.

Just-in-time scheduling works best, from the management point of view, when a company maintains a vast roster of eager part-time workers (who receive no health insurance, sick leave or other benefits). As a result, hourly workers at large retailers such as Target and Walmart routinely complain they are assigned only one or two days of work per week. But with a tight economy, they can't afford to quit, and the unpredictability of their schedules makes it difficult to attend classes or hold a second job. Lambert says the practice allows employers to "pass the risk of uncertainty in their business" onto their lowest-paid workers.

More than a third of the American workforce today is classified as low-wage (defined as earning less than two-thirds of the median earnings of male employees in the U.S., or about $13 an hour in 2010). And that figure is expected to grow. Low-wage jobs accounted for 76 percent of net job growth last year. The top four fastest-growing occupations — retail salespersons, cashiers, food preparation and food service workers such as waiters and waitresses — all pay national median hourly wages of less than $10. Most of those jobs, labor analysts say, will be filled by prime-age workers, who often cobble together more than one part-time job to make ends meet.

A year ago, President Barack Obama, citing the White House report "Work-Life Balance and the Economics of Workplace Flexibility," argued that American labor practices and policies have not kept pace with the changing economy and employment market.

Lambert and others agree that U.S. labor policy remains rooted in the nostalgic household ideal of a 9-to-5 husband with a stay-at-home wife. In fact, the number of women in the workforce is now more than double what it was in 1950 and is now essentially equal to the total for men. And earlier this year, the Census Bureau announced that for the first time in U.S. history, married couples account for less than half of all households, highlighting the importance of flexible work arrangements. Meanwhile, part-time jobs are replacing full-time positions in many low-paying industries as employers look to trim labor costs.

To be sure, many of those full-time jobs disappear as employers maneuver around the associated costs of health insurance, paid sick leave, severance pay and other benefits. In response, a few policy proposals have been floated, reflecting the changing employment patterns. Among them: expanding federal protections for part-time workers; a minimum weekly hour guarantee; and required flexible scheduling options. Others argue that federal labor laws should apply to small businesses, not just those with 50 or more employees, as under current law.

But opposition from employers remains strong and few political leaders champion the cause, a fact not lost on Lambert. "One of the goals of government is to mediate between the market and individuals," she says. "The market is volatile, and individuals need stability."

Lisa Horn, senior government relations adviser at the Society for Human Resource Management, says corporate America needs no prodding. Little by little, she insists, industries that rely on low-wage workers are adopting policies to promote better work-life balance. "There [is] still a lot more that companies can do, but legislative remedies are not the answer," she says. "If anything, [they] would hamstring employers from finding creative solutions to the work-life challenge."

Part of the solution must come from better awareness, adds Jennifer Swanberg, executive director of the Institute for Workplace Innovation at the University of Kentucky and the co-author of the report "Flexible Workplace Solutions for Low-Wage Hourly Workers: A Framework for a National Conversation." She notes a lingering "flexibility stigma" attached to low-wage workers at many firms. A study of call center employees found that hourly workers who participated in programs to enhance work-life balance received lower job performance ratings than workers who declined them. In another study, 94 percent of retail store managers say they favored workers who are willing to work any time the store is open. Indeed, only 28 percent of low-wage workers strongly believe that flexible work arrangements do not jeopardize career advancement.

With union influence ebbing, and with no clear legislative mandate on the horizon, Lambert says the pressure on companies to adopt worker-friendly policies such as flexible schedules, sick leave, vacation pay or shift-swapping must come from within. And that will happen, she believes, when employers are presented with the hard data showing that better work-life balance among its low-wage workforce makes good business sense.

Lambert's ongoing Scheduling Intervention Study has repeatedly shown that family-friendly policies for low-wage workers — both full time and part time – build employee satisfaction and loyalty and, in turn, reduce turnover. The study shows that total hours worked, the stability of hours worked week to week, and the option of flexible scheduling all correlate highly with employee retention. They also correlate with reduced stress, better health and stronger personal relationships.

In short, turnover declines when workers are better able to balance work-life conflicts. Studies also reveal that turnover is lower when part-time worker rolls are kept low, thus guaranteeing workers more hours.

And turnover isn't cheap. Virginia-based workforce management consultant Lisa Disselkamp calculates the cost at an average of 30 percent of a worker's annual wage, or $6,000 for someone earning $20,000. If a large retailer replaces 300 workers annually, as some do, she reports, finding new ones can cost $1.8 million.

The next phase of Lambert's Chicago clothing retailers study will examine intervention strategies, such as computerized scheduling, and better oversight and training for store managers. "We need accountability mechanisms for frontline managers," Lambert says. "We assume they are making rational choices, but that's very often not what we see."

Similar efforts to educate employers are under way at the University of California Hastings College of Law's Center for WorkLife Law. Earlier this year, the center produced a comprehensive report, "Improving Work-Life Fit in Hourly Jobs: An Underutilized Cost-Cutting Strategy in a Globalized World," outlining strategies such as shift-swapping, compressed work weeks, online scheduling, job sharing and personal leave in one-hour increments.

The report provides employers with real-world examples of successful work-life balance policies. Among them: Employee Resources Group, a Kentucky-based hotel staffing firm, which allows low-wage workers with young children to schedule shifts to coincide with school hours; and Marriott's global call center in Salt Lake City, which provides employees with flex-time coupons that can be used in hourly increments, allowing workers time off for personal and family needs.

Such policies are the exception, says Stephanie Bornstein, deputy director of the Center for WorkLife Law. "Managers still look at work-life-balance policies as a benefit for higher-paid workers, like themselves, not for part-timers and hourly employees," she says. "It's pretty evident that this kind of thinking is bad for the bottom line."

Firms that rely on low-wage workers are ignoring the data. When the career-services website Glassdoor.com released its ranking in May of U.S. employers with the best work-life balance policies, not a single firm from low-paying industries made the top 25. Lambert isn't surprised. "Company policies tend to reflect a bias toward higher-wage workers," she says. "The people who benefit most are the ones making the rules."

http://www.miller-mccune.com/business-economics/work-life-balance-benefits-low-wage-workers-employers-35733/

Bedrock Nitrogen May Help Forests Buffer Climate Change, Study Finds

The forests of South Fork Mountain in northern California draw nitrogen from bedrock, making them some of the state's most productive forests. Understanding and quantifying this newly identified source of nitrogen may significantly impact scientists understanding of forest productivity, carbon storage and nitrogen cycling on land. (Credit: Photo by Scott Morford/UC Davis)

ScienceDaily (Sep. 6, 2011) — For the first time, researchers at the University of California, Davis, have demonstrated that forest trees have the ability to tap into nitrogen found in rocks, boosting the trees' growth and their ability to pull more carbon dioxide from the atmosphere.

Given that carbon dioxide is the most important climate-change gas, the nitrogen in rocks could significantly affect how rapidly Earth will warm in the future, the researchers say. They report their findings in the Sept. 1 issue of the scientific journal *Nature*.

If trees can access more nitrogen than previously thought, that could lead to more storage of carbon on land and less carbon remaining in the atmosphere.

"We were really shocked; everything we've ever thought about the nitrogen cycle and all of the textbook theories have been turned on their heads by these data," said Professor Benjamin Houlton, a biogeochemist and one of the study's co-authors.

"Findings from this study suggest that our climate-change models should not only consider the importance of nitrogen from the atmosphere, but now we also have to start thinking about how rocks may affect climate change," he said.

The importance of nitrogen

Nitrogen, found in such vital molecules as DNA and protein, is necessary for all life and is used worldwide as a fertilizer for food crops. It is the nutrient that most often limits plant growth in natural ecosystems.

It was previously believed that nitrogen could only enter ecosystems from the atmosphere -- either dissolved in rainwater or biologically "fixed" or assimilated by specialized groups of plants and other organisms. Because the amount of nitrogen in these atmospheric pathways is rather limited, it was thought that most ecosystems could not get enough of this vital nutrient to facilitate plant growth at maximum rates.

Following this line of thought, it was estimated that the nitrogen contribution from rocks in Northern California was on the same order as atmospheric nitrogen sources, made available through fixation and deposited via rainwater.

"To put it in perspective, there is enough nitrogen contained in one inch of the rocks at our study site to completely support the growth of a typical coniferous forest for about 25 years," said Professor Randy Dahlgren, a biogeochemist and a study co-author.

"This nitrogen is released slowly over time and helps to maintain the long-term fertility of many California forests," Dahlgren said. "It is also interesting to consider that the nitrogen in the rocks from our study site originates from the time of the dinosaurs, when plant and animal remains were incorporated into the sediments that eventually formed the rocks."

The UC Davis findings

The UC Davis study, led by Scott Morford, a graduate student in the Department of Land, Air and Water Resources, focused on measuring the nitrogen in rocks, soils and plants, and found that rocks enriched in nitrogen have a profound effect on the fertility of forests.

Data from the study indicate that the amount of carbon stored in forest soils derived from the nitrogen-rich bedrock was nearly twice that of sites associated with nitrogen-poor rocks in Northern California. Furthermore, the researchers used the inventory of forest growth data from the National Forest Service to determine that this was not just a localized effect. In fact, the productivity of forests growing on nitrogen-rich rock was approximately 50 percent higher than the productivity of forests growing on nitrogen-poor rocks throughout Northern California and into Oregon.

"We were all stunned when the data showed that the nitrogen in the trees was extremely high in forests that were living on the rocks with high nitrogen," said Morford.

To confirm the link between the nitrogen in the trees and that in the surrounding rock, the researchers traced the nitrogen from the rocks using the different isotopes of nitrogen. They found that the nitrogen isotopes in the rock matched those of the soils and trees, confirming that the nitrogen was coming from the rocks.

"It was like a fingerprint; we found the culprit, and it was the nitrogen in the rocks," Morford said.

Implications for climate change

The researchers stress that, since nitrogen tends to be elevated in rocks of sedimentary origin, which cover roughly 75 percent of Earth's land surface, the discovery that bedrock nitrogen has the potential to stimulate forest productivity and carbon storage has tremendous global significance.

"The stunning finding that forests can also feed on nitrogen in rocks has the potential to change all projections related to climate change," said Houlton. "This discovery may also help explain several other studies that have found that the nitrogen 'budgets' of forests are out of balance, the nitrogen accumulation in their soil and plants being substantially greater than the apparent nitrogen inputs."

Houlton noted that nitrogen is becoming increasingly important in climate-change studies and researchers have begun to incorporate nitrogen in their climate-change models. Some models indicate that the nutrient could cause an additional increase in global temperatures of up to one degree Celsius (1.8 degrees Fahrenheit), as it limits the amount of carbon dioxide that plants around the world can extract from the atmosphere. If more nitrogen is available than predicted from the traditional nitrogen-cycling pathways, as the UC Davis study suggests, it could lead to more carbon storage on land and less carbon remaining in the atmosphere.

The researchers call for further studies in other parts of the world to determine if nitrogen in rocks affects forests outside of the Pacific Northwest.

Morford is continuing his research and during the past year has collected more than 800 rocks from Oregon to San Diego. A goal of this future research is to determine how fast nitrogen is released from rocks under the varying environmental conditions in California and beyond.

This study was funded by the Andrew W. Mellon Foundation, the Packard Foundation, and the Kearney Foundation for Soil Science.

Story Source:

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1. Scott L. Morford, Benjamin Z. Houlton, Randy A. Dahlgren. **Increased forest ecosystem carbon and nitrogen storage from nitrogen rich bedrock**. *Nature*, 2011; 477 (7362): 78 DOI: 10.1038/nature10415

http://www.sciencedaily.com/releases/2011/08/110831155347.htm

New Map Shows Where Tastes Are Coded in the Brain

Shown in the background is an image of the taste cortex of a mouse brain highlighting its vasculature tree structure. Superimposed are foods illustrating the topographic segregation of the different taste qualities, with each basic taste being represented in its own cortical domain. The individual domains were discovered by functional 2-photon imaging studies following stimulation of the tongue with sweet, bitter, salty and umami tastants. (Credit: Laboratory of Charles Zuker/HHMI at Columbia University)

ScienceDaily (Sep. 5, 2011) — Each taste, from sweet to salty, is sensed by a unique set of neurons in the brains of mice, new research reveals. The findings demonstrate that neurons that respond to specific tastes are arranged discretely in what the scientists call a "gustotopic map." This is the first map that shows how taste is represented in the mammalian brain.

There's no mistaking the sweetness of a ripe peach for the saltiness of a potato chip -- in part due to highly specialized, selectively-tuned cells in the tongue that detect each unique taste. Now, Howard Hughes Medical Institute and NIH scientists have added to our understanding of how we perceive taste, showing that four of our basic tastes -- sweet, bitter, salty, and "umami," or savory -- are also processed by distinct areas of the brain. The researchers published their work in the September 2, 2011, issue of the journal *Science*.

"This work further reveals coding in the taste system via labeled lines, and it exposes the basic logic for the brain representation of the last of the classical five senses," said Howard Hughes Medical Institute investigator Charles S. Zuker, who is at Columbia University College of Physicians and Surgeons.

"The way that we perceive the sensory world has been something that's fascinated humanity throughout our whole existence," says Nicholas J. P. Ryba of the National Institute of Dental and Craniofacial Research, who collaborated with Zuker on the new study. "What is a taste, really? It's the firing of a set of neurons in the brain, and that's what we want to understand."

In the past, researchers had measured the electrical activity of small clusters of neurons to see which areas of a mouse's brain were activated by different tastes. In those experiments, the areas responding to different tastes seemed to blend together, and scientists therefore concluded that neurons appeared to process all tastes broadly.

Zuker, Ryba, and other collaborators had previously identified unique taste receptors and taste receptor cells for each taste -- uncovering a "one taste, one cell class" coding scheme. Activating these receptor cells triggered innate behaviors in mice: attraction to sweet, umami, and low salt and aversion to bitter, sour, and high salt. With this clear link between taste and "hardwired" behaviors, the researchers wondered why

different tastes would be processed by the same neurons in the brain. They suspected that the previous experiments had missed something. So Xiaoke Chen, a postdoctoral associate in Zuker's lab tried a powerful new technique, called two-photon calcium imaging, to determine which neurons responded when an animal is exposed to different taste qualities.

When a neuron is activated, it releases a wave of calcium throughout the cell. So the level of calcium can serve as a proxy for measuring activation of neurons. The researchers injected dye into the neurons of mice that made those cells light up with fluorescence every time calcium was released. Then, they looked at the brains of the mice under high-powered microscopes that allowed them to watch hundreds of nerve cells at a time deep within the brain of mice. When a cell was activated, the researchers saw it fluoresce. This allowed them to monitor the activity of large ensembles of cells, as opposed to previous methods, which tracked only a few cells at a time. They observed that when a mouse is given something bitter to taste, or the receptors on its tongue that sense bitter are stimulated, many neurons in one small, specific area of the brain light up. When the mouse is given something salty, an area a few millimeters away is activated. Each taste corresponded to a different hotspot in the brain. None of the areas overlapped -- in fact, there was space between all of them.

"The idea of maps in the brain is one that has been found in other senses," says Ryba. "But in those cases the brain maps correspond to external maps." Different frequencies of sound activate different sets of neurons, for example. In the case of these auditory neurons, the map is arranged in order of frequency, from the lowest to the highest. Visual neurons are found in an arrangement that mimics the field of vision sensed by the eyes. However, taste offers no preexisting arrangement before reaching the brain; furthermore, the receptors for all tastes are found randomly throughout the tongue -- thus the spatial organization of taste neurons into a topographic brain map is all the more surprising.

Zuker says that now the team has discovered a brain map for taste qualities, they next want to uncover "how taste combines with other sensory inputs like olfaction and texture, and the internal state -- hunger and expectation, for example -- to choreograph flavor, taste memories, and taste behaviors."

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1. Xiaoke Chen, Mariano Gabitto, Yueqing Peng, Nicholas J. P. Ryba, Charles S. Zuker. **A Gustotopic Map of Taste Qualities in the Mammalian Brain**. *Science*, 2 September 2011: Vol. 333 no. 6047 pp. 1262-1266 DOI: 10.1126/science.1204076

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Sparing or Sharing? Protecting Wild Species May Require Growing More Food On Less Land

Farming in India. Researchers collected information on more than 600 species in southwest Ghana and northern India, two parts of the world where demand for agricultural land is putting ever more pressure on wild species. (Credit: © muralinathypr / Fotolia)

ScienceDaily (Sep. 5, 2011) — In parts of the world still rich in biodiversity, separating natural habitats from high-yielding farmland could be a more effective way to conserve wild species than trying to grow crops and conserve nature on the same land, according to a new study published on September 2, 2011 in the journal *Science*.

The study, by researchers at the University of Cambridge and the Royal Society for the Protection of Birds, collected information on more than 600 species in southwest Ghana and northern India, two parts of the world where demand for agricultural land is putting ever more pressure on wild species. The researchers measured crop production as well as the abundances of birds and trees in forests and in various types of farmland.

"Farmland with some retained natural vegetation had more species of birds and trees than high-yielding monocultures of oil palm, rice or wheat but produced far less food energy and profit per hectare," said lead author Dr Ben Phalan from the University of Cambridge. "As well as requiring more land to produce the same amount of food, the 'wildlife-friendly' farmlands were not as wildlife-friendly as they first appeared. Compared with forest, they failed to provide good habitat for the majority of bird and tree species in either region."

The researchers discovered that, under current and future scenarios of food demand, most species would have larger total populations if farming was restricted to the smallest area feasible, while protecting as much natural forest as possible. This was true not just for rare species but for common species as well.

This strategy, called 'land sparing', uses higher yields on existing farmland to spare land for nature (in contrast with 'land sharing', which aims to conserve wild species and grow crops on the same land). Because high-yield farming produced more food from less land, it could be used as part of a strategy to protect larger tracts of natural habitats such as forest.

"It would be nice to think that we could conserve species and produce lots of food, all on the same land," said study author, Dr Malvika Onial from the University of Cambridge. "But our data from Ghana and India show that's not the best option for most species. To produce a given amount of food, it would be better for biodiversity to farm as productively as possible, if that allows more natural habitat to be protected or restored."

"It is critical to note that increasing crop yields would not work in isolation," said study author Professor Andrew Balmford from the University of Cambridge. "Such increases need to be combined with active measures such as national parks and community reserves to protect natural habitats from conversion to farmland. Conservation policy-makers should explore new ways to link protection of natural habitats with efforts to increase food yield per unit area in sustainable ways. Food retailers could perhaps make these linkages a feature of environmentally-friendly food products."

The researchers cautioned, however, that although their findings in Ghana and India are remarkably consistent, they may not hold true everywhere. It is possible that land sparing will be a better strategy in some places and land sharing in others. They advise that further studies in representative parts of the world are needed to determine whether there is a more general pattern.

"Our study does not give uncritical support to large-scale agribusiness over small-scale farming systems," said study author Professor Rhys Green from the Royal Society for the Protection of Birds and the University of Cambridge. "High-yielding organic farming and other systems such as agroforestry can be a useful component of a land sparing strategy and may offer the additional advantage of fewer adverse effects of farming from fertilisers and pesticides. But whatever the farming system, protection of natural habitats will continue to be essential for the conservation of many species."

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Story Source:

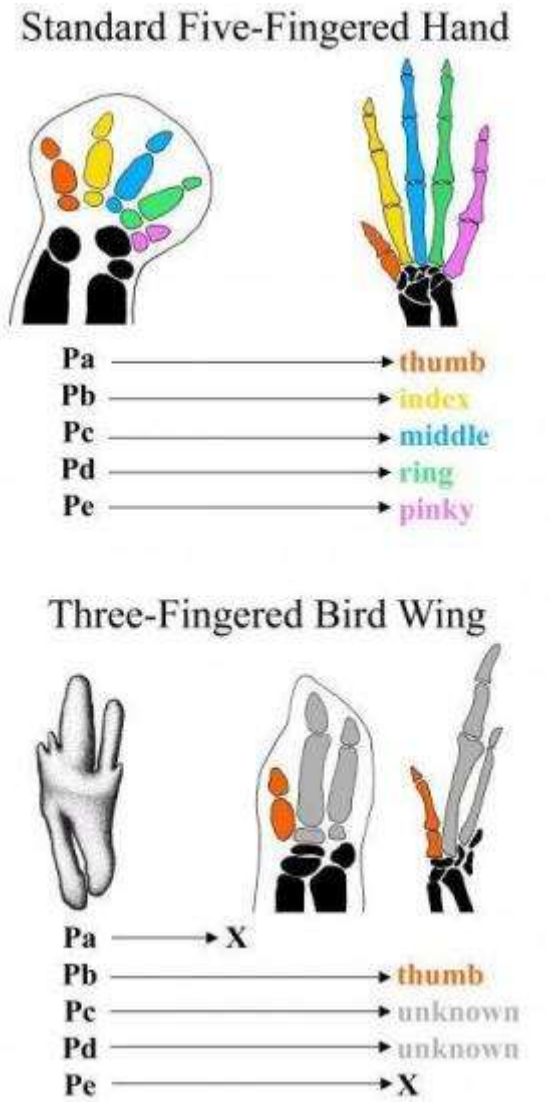
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Cambridge**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Ben Phalan, Malvika Onial, Andrew Balmford, Rhys E. Green,. **Reconciling food production and biodiversity conservation: land sharing and land sparing compared**. *Science*, 2 September 2011: Vol. 333 no. 6047 pp. 1289-1291 DOI: 10.1126/science.1208742

http://www.sciencedaily.com/releases/2011/09/110901142102.htm

Mystery of Disappearing Bird Digit Solved?



A genomic analysis shows that precursor cells pb that form index finger in five-fingered vertebrates can form the "thumb" (in orange) or first digit in three-digit bird wing (Credit: Courtesy Yale University)

ScienceDaily (Sep. 5, 2011) — What is the origin of digits in birds? The question has long puzzled evolutionary biologists. Using genomic analysis, researchers have now solved a key part of this mystery.

Evolution adds and subtracts, and nowhere is this math more evident than in vertebrates, which are programmed to have five digits on each limb. But many species do not. Snakes, of course, have no digits, and birds have three.

Yale scientists now have a good handle on how these developmental changes are orchestrated in the embryo. But there is still one outstanding debate on birds: Which digits are they? A thumb with index and middle fingers, or the index, middle and ring fingers?

In five-digit vertebrates, the thumb comes from the precursor stem cells labeled pa. While birds have a digit that looks like a thumb, pa precursor cells die off during development and never produce a digit in adults. As a result, scientists have wondered whether precursor cells in pb can make a thumb.

Yale scientists have completed a genomic analysis of birds that reveals the answer. It is a hands-down "yes" -- even though the first bird digit develops where the index finger on a five-finger vertebrae should be.

The results are published online Sept. 4 in the journal *Nature*. Authors are Zhe Wang, Rebecca L. Young, Huiling Xue, and Gunter P. Wagner from the Department of Ecology and Evolutionary Biology.

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Story Source:

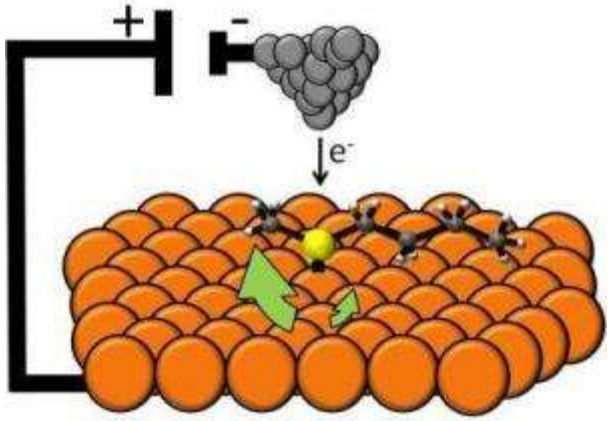
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Yale University**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Zhe Wang, Rebecca L. Young, Huiling Xue, Günter P. Wagner. **Transcriptomic analysis of avian digits reveals conserved and derived digit identities in birds**. *Nature*, 2011; DOI: 10.1038/nature10391

http://www.sciencedaily.com/releases/2011/09/110904140359.htm

World's Smallest Electric Motor Made from a Single Molecule



Chemists at Tufts University have developed the world's first single molecule electric motor, which may potentially create a new class of devices that could be used in applications ranging from medicine to engineering. The molecular motor was powered by electricity from a state of the art, low-temperature scanning tunneling microscope. This microscope sent an electrical current through the molecule, directing the molecule to rotate in one direction or another. The molecule had a sulfur base (yellow); when placed on a conductive slab of copper (orange), it became anchored to the surface. The sulfur-containing molecule had carbon and hydrogen atoms radiating off to form what looks like two arms (gray); these carbon chains were free to rotate around the central sulfur-copper bond. The researchers found that reducing the temperature of the molecule to five Kelvin (K), or about minus 450 degrees Fahrenheit (ºF), enabled them to precisely impact the direction and rotational speed of the molecular motor The Tufts team plans to submit this miniature electric motor to the Guinness World Records. The research was published online Sept. 4 in Nature Nanotechnology. (Credit: Heather L. Tierney, Colin J. Murphy, April D. Jewell, Ashleigh E. Baber, Erin V. Iski, Harout Y. Khodaverdian, Allister F. McGuire, Nikolai Klebanov and E. Charles H. Sykes.)

ScienceDaily (Sep. 5, 2011) — The smallest electrical motor on the planet, at least according to *Guinness World Records*, is 200 nanometers. Granted, that's a pretty small motor -- after all, a single strand of human hair is 60,000 nanometers wide -- but that tiny mark is about to be shattered in a big way.

Chemists at Tufts University's School of Arts and Sciences have developed the world's first single molecule electric motor, a development that may potentially create a new class of devices that could be used in applications ranging from medicine to engineering.

In research published online Sept. 4 in *Nature Nanotechnology*, the Tufts team reports an electric motor that measures a mere 1 nanometer across, groundbreaking work considering that the current world record is a 200 nanometer motor. A single strand of human hair is about 60,000 nanometers wide.

According to E. Charles H. Sykes, Ph.D., associate professor of chemistry at Tufts and senior author on the paper, the team plans to submit the Tufts-built electric motor to *Guinness World Records.*

"There has been significant progress in the construction of molecular motors powered by light and by chemical reactions, but this is the first time that electrically-driven molecular motors have been demonstrated, despite a few theoretical proposals," says Sykes. "We have been able to show that you can provide electricity to a single molecule and get it to do something that is not just random."

Sykes and his colleagues were able to control a molecular motor with electricity by using a state of the art, low-temperature scanning tunneling microscope (LT-STM), one of about only 100 in the United States. The LT-STM uses electrons instead of light to "see" molecules.

The team used the metal tip on the microscope to provide an electrical charge to a butyl methyl sulfide molecule that had been placed on a conductive copper surface. This sulfur-containing molecule had carbon and hydrogen atoms radiating off to form what looked like two arms, with four carbons on one side and one on the other. These carbon chains were free to rotate around the sulfur-copper bond.

The team determined that by controlling the temperature of the molecule they could directly impact the rotation of the molecule. Temperatures around 5 Kelvin (K), or about minus 450 degrees Fahrenheit (ºF), proved to be the ideal to track the motor's motion. At this temperature, the Tufts researchers were able to track all of the rotations of the motor and analyze the data.

While there are foreseeable practical applications with this electric motor, breakthroughs would need to be made in the temperatures at which electric molecular motors operate. The motor spins much faster at higher temperatures, making it difficult to measure and control the rotation of the motor.

"Once we have a better grasp on the temperatures necessary to make these motors function, there could be real-world application in some sensing and medical devices which involve tiny pipes. Friction of the fluid against the pipe walls increases at these small scales, and covering the wall with motors could help drive fluids along," said Sykes. "Coupling molecular motion with electrical signals could also create miniature gears in nanoscale electrical circuits; these gears could be used in miniature delay lines, which are used in devices like cell phones."

The Changing Face of Chemistry

Students from the high school to the doctoral level played an integral role in the complex task of collecting and analyzing the movement of the tiny molecular motors.

"Involvement in this type of research can be an enlightening, and in some cases life changing, experience for students," said Sykes. "If we can get people interested in the sciences earlier, through projects like this, there is a greater chance we can impact the career they choose later in life."

As proof that gaining a scientific footing early can matter, one of the high school students involved in the research, Nikolai Klebanov, went on to enroll at Tufts; he is now a sophomore majoring in chemical engineering.

This work was supported by the National Science Foundation, the Beckman Foundation and the Research Corporation for Scientific Advancement.

Tufts University, located on three Massachusetts campuses in Boston, Medford/Somerville, and Grafton, and in Talloires, France, is recognized among the premier research universities in the United States. Tufts enjoys a global reputation for academic excellence and for the preparation of students as leaders in a wide range of professions. A growing number of innovative teaching and research initiatives span all campuses, and collaboration among the faculty and students in the undergraduate, graduate and professional programs across the university is widely encouraged.

Story Source:

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

Journal Reference:

1. Heather L. Tierney, Colin J. Murphy, April D. Jewell, Ashleigh E. Baber, Erin V. Iski, Harout Y. Khodaverdian, Allister F. McGuire, Nikolai Klebanov, E. Charles H. Sykes. **Experimental demonstration of a single-molecule electric motor**. *Nature Nanotechnology*, 2011; DOI: 10.1038/NNANO.2011.142

http://www.sciencedaily.com/releases/2011/09/110904140353.htm

First Stem Cells from Endangered Species

Drill primate (Credit: San Diego Zoo)

ScienceDaily (Sep. 5, 2011) — Starting with normal skin cells, scientists from The Scripps Research Institute have produced the first stem cells from endangered species. Such cells could eventually make it possible to improve reproduction and genetic diversity for some species, possibly saving them from extinction, or to bolster the health of endangered animals in captivity.

A description of the accomplishment appeared in an advance online edition of the journal *Nature Methods* on September 4, 2011.

Genesis

About five years ago, Oliver Ryder, PhD, the director of genetics at the San Diego Zoo Institute for Conservation Research, contacted Jeanne Loring, PhD, professor of developmental neurobiology at Scripps Research, to discuss the possibility of collecting stem cells from endangered species. Ryder's team had already established the Frozen Zoo, a bank of skin cells and other materials from more than 800 species and wondered if the thousands of samples they had amassed might be used as starting points.

Just as is hoped with humans, Ryder thought stem cells from endangered species might enable lifesaving medical therapies or offer the potential to preserve or expand genetic diversity by offering new reproduction possibilities.

At the time, although researchers were working with stem cells from embryos, scientists had not yet developed techniques for reliably inducing normal adult cells to become stem cells. But the technology arrived soon after, and scientists now accomplish this feat, called induced pluripotency, by inserting genes in normal cells that spark the transformation.

While Loring's team met with Ryder in early 2008, they realized that these newly emerging techniques might be applied to endangered species. Postdoctoral fellow Inbar Friedrich Ben-Nun, PhD, set out to systematically explore the possibilities.

Ryder suggested two species for initial work. The first was a highly endangered primate called a drill that he chose because of its close genetic connection to humans, and because in captivity the animals often suffer from diabetes, which researchers are working to treat in humans using stem cell-based therapies.

The northern white rhinoceros was the second candidate. Ryder chose this animal because it is genetically far removed from primates, and because it is one of the most endangered species on the planet. There are only seven animals still in existence, two of which reside at the San Diego Zoo Safari Park.

Initially members of the team thought they would have to isolate and use genes from animals closely related to the endangered species to successfully induce pluripotency. But that line of experimentation didn't work. Instead, to their surprise, after a year of trial and error, the researchers found that the same genes that induce pluripotency in humans also worked for the drill and the rhino. "It has been just amazing," said Ryder of the Scripps Research team's successes.

The process is inefficient, meaning only a few stem cells are produced at a time, but that's enough. "There are only two animals in it," said Ben-Nun, "but we have the start of a new zoo, the stem cell zoo."

Stem Cells to the Rescue

The scientists view their success as a first step toward greater advancements. Besides the possibility of using stem cells as the basis for diabetes or other treatments, there is great potential for new reproductive technologies as the stem cell research field advances. "The most important thing is to provide these stem cells as a resource for other people taking some of the next steps," said Loring.

One of the greatest concerns with small populations such as the northern white rhinos is that even if they did reproduce, which hasn't happened in many years, their genetic diversity is inevitably and dangerously low, and such inbreeding leads to unhealthy animals.

But researchers are moving toward inducing stem cells to differentiate into sperm or egg cells. With that accomplished, one possibility is that scientists could take skin cells in the Frozen Zoo from long dead animals, induce pluripotency, trigger differentiation into sperm cells, and then combine these with a living animal's eggs through in vitro fertilization. Otherwise-lost genetic diversity would then be reintroduced into the population, making it healthier, larger, and more robust.

Or, both eggs and sperm might be produced from the stem cells, with the resulting embryos implanted in live animals, a process that current research suggests could be much more reliable than existing cloning techniques.

Scientists are already exploring the possibility of producing sperm and eggs from stem cells as a potential solution to human infertility issues. Loring hopes that some of these groups might consider initial technique development using endangered species stem cells. "I think that work would be a lot easier ethically with

endangered species than with humans," she said, "so I suspect some people working in this area would love to have our cells for experiments."

The Real Solution

"The best way to manage extinctions is to preserve species and their habitats," said Ryder, "but that's not working all the time." The rhinos are a perfect example, he said, because there are so few. "Stem cell technology provides some level of hope that they won't have to become extinct even though they've been completely eliminated from their habitats. I think that if humankind wants to save this species, we're going to have to develop new methodologies."

And even when there are reasonable wild populations of a species, they face a range of threats, including loss of habitat and poaching.

Moving forward, Loring said the group is hoping to continue producing stem cells from other species to expand their fledgling stem cell "zoo." For now, they're working to secure funding for what amounts to an unconventional line of research. "It's in between fields," said Loring. "It's not classical conservation and it's not ordinary biological research."

This research was supported by the Esther O'Keefe Foundation, the Millipore Foundation, and the California Institute for Regenerative Medicine.

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Journal Reference:

1. Inbar Friedrich Ben-Nun, Susanne C Montague, Marlys L Houck, Ha T Tran, Ibon Garitaonandia, Trevor R Leonardo, Yu-Chieh Wang, Suellen J Charter, Louise C Laurent, Oliver A Ryder, Jeanne F Loring. **Induced pluripotent stem cells from highly endangered species**. *Nature Methods*, 2011; DOI: 10.1038/nmeth.1706

http://www.sciencedaily.com/releases/2011/09/110904140411.htm