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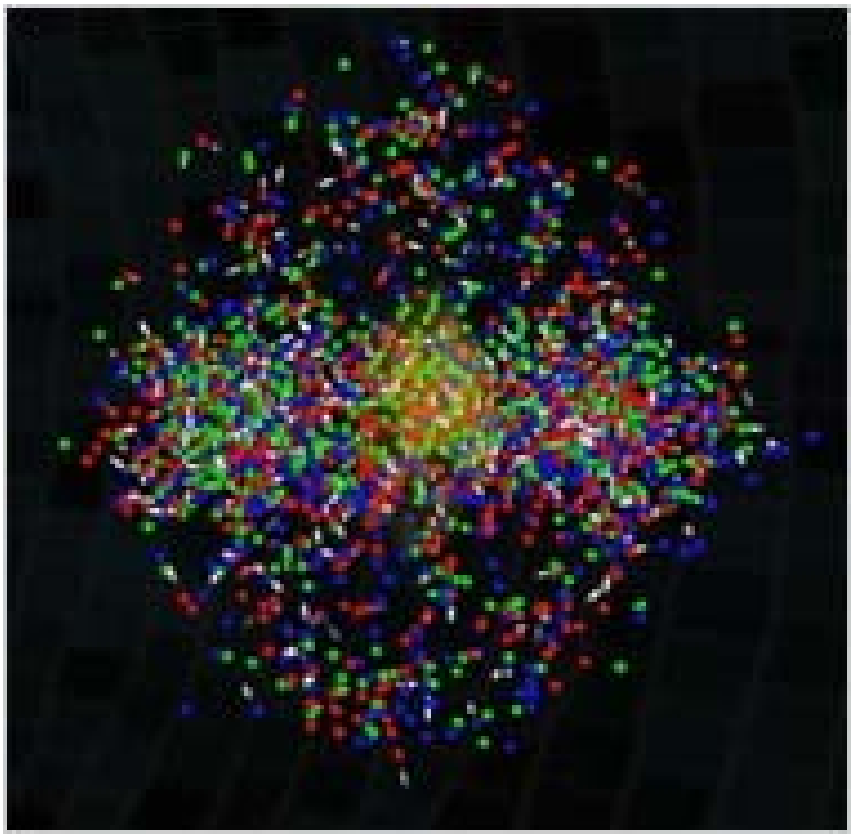
In Brookhaven Collider, Scientists Briefly Break a Law of Nature

By DENNIS OVERBYE



Physicists said Monday that they had whacked a tiny region of space with enough energy to briefly distort the laws of physics, providing the first laboratory demonstration of the kind of process that scientists suspect has shaped cosmic history.

The blow was delivered in the Relativistic Heavy Ion Collider, or RHIC, at the Brookhaven National Laboratory on Long Island, where, since 2000, physicists have been accelerating gold nuclei around a 2.4-mile underground ring to 99.995 percent of the speed of light and then colliding them in an effort to melt protons and neutrons and free their constituents — quarks and gluons. The goal has been a state of matter called a quark-gluon plasma, which theorists believe existed when the universe was only a microsecond old.

The departure from normal physics manifested itself in the apparent ability of the briefly freed quarks to tell right from left. That breaks one of the fundamental laws of nature, known as parity, which requires that the laws of physics remain unchanged if we view nature in a mirror.

This happened in bubbles smaller than the nucleus of an atom, which lasted only a billionth of a billionth of a billionth of a second. But in these bubbles were "hints of profound physics," in the words of Steven Vigdor, associate director for nuclear and particle physics at Brookhaven. Very similar symmetry-breaking bubbles, at an earlier period in the universe, are believed to have been responsible for breaking the balance between matter and its opposite antimatter and leaving the universe with a preponderance of matter.

"We now have a hook" into how these processes occur, Dr. Vigdor said, adding in an e-mail message, "IF the interpretation of the RHIC results turns out to be correct." Other physicists said the results were an important window into the complicated dynamics of quarks, which goes by the somewhat whimsical name of Quantum Chromo Dynamics.

Frank Wilczek, a physicist at the Massachusetts Institute of Technology who won the Nobel Prize for work on the theory of quarks, called the new results "interesting and surprising," and said understanding them would help understand the behavior of quarks in unusual circumstances.

"It is comparable, I suppose, to understanding better how galaxies form, or astrophysical black holes," he said.

The Brookhaven scientists and their colleagues discussed their latest results from RHIC in talks and a news conference at a meeting of the American Physical Society Monday in Washington, and in a pair of papers submitted to Physical Review Letters. "This is a view of what the world was like at 2 microseconds," said Jack Sandweiss of Yale, a member of the Brookhaven team, calling it, "a seething cauldron."

Among other things, the group announced it had succeeded in measuring the temperature of the quark-gluon plasma as 4 trillion degrees Celsius, "by far the hottest matter ever made," Dr. Vigdor said. That is 250,000 times hotter than the center of the Sun and well above the temperature at which theorists calculate that protons and neutrons should melt, but the quark-gluon plasma does not act the way theorists had predicted.

Instead of behaving like a perfect gas, in which every quark goes its own way independent of the others, the plasma seemed to act like a liquid. "It was a very big surprise," Dr. Vigdor said, when it was discovered in 2005. Since then, however, theorists have revisited their calculations and found that the quark soup can be either a liquid or a gas, depending on the temperature, he explained. "This is not your father's quark-gluon plasma," said Barbara V. Jacak, of the State University at Stony Brook, speaking for the team that made the new measurements.

It is now thought that the plasma would have to be a million times more energetic to become a perfect gas. That is beyond the reach of any conceivable laboratory experiment, but the experiments colliding lead nuclei in the Large Hadron Collider outside Geneva next winter should reach energies high enough to see some evolution from a liquid to a gas.

Parity, the idea that the laws of physics are the same when left and right are switched, as in a mirror reflection, is one of the most fundamental symmetries of space-time as we know it. Physicists were surprised to discover in 1956, however, that parity is not obeyed by all the laws of nature after all. The universe is slightly lopsided in this regard. The so-called weak force, which governs some radioactive decays, seems to be left-handed, causing neutrinos, the ghostlike elementary particles that are governed by that force, to spin clockwise, when viewed oncoming, but never counterclockwise.

Under normal conditions, the laws of quark behavior observe the principle of mirror symmetry, but Dmitri Kharzeev of Brookhaven, a longtime student of symmetry changes in the universe, had suggested in 1998 that those laws might change under the very abnormal conditions in the RHIC fireball. Conditions in that fireball are such that a cube with sides about one quarter the thickness of a human hair could contain the total amount of energy consumed in the United States in a year.

All this energy, he said, could put a twist in the gluon force fields, which give quarks their marching orders. There can be left-hand twists and right-hand twists, he explained, resulting in space within each little bubble getting a local direction.

What makes the violation of mirror symmetry observable in the collider is the combination of this corkscrewed space with a magnetic field, produced by the charged gold ions blasting at one another. The quarks were then drawn one way or the other along the magnetic field, depending on their electrical charges.

The magnetic fields produced by the collisions are the most intense ever observed, roughly 100 million billion gauss, Dr. Sandweiss said.

The directions of the magnetic field and of the corkscrew effect can be different in every bubble, the presumed parity violations can only be studied statistically, averaged over 14 million bubble events. In each of them, the mirror symmetry could be broken in a different direction, Dr. Sandweiss explained, but the effect would always be the same, with positive quarks going one way and negative ones the other. That is what was recorded in RHIC's STAR detector (STAR being short for Solenoidal Tracker at RHIC) by Dr. Sandweiss and his colleagues. Dr. Sandweiss cautioned that it was still possible that some other effect could be mimicking the parity violation, and he d held off publication of the results for a year, trying unsuccessfully to find one. So they decided, he said, that it was worthy of discussion.

One test of the result, he said, would be to run RHIC at a lower energy and see if the effect went away when there was not enough oomph in the beam to distort space-time. The idea of parity might seem like a very abstract and mathematical concept, but it affects our chemistry and biology. It is not only neutrinos that are skewed. So are many of the molecules of life, including proteins, which are left-handed, and sugars, which are right-handed.

The chirality, or handedness, of molecules prevents certain reactions from taking place in chemistry and biophysics, Dr. Sandweiss noted, and affects what we can digest.

Physicists suspect that the left-handedness of neutrinos might have contributed to the most lopsided feature of the universe of all, the fact that it is composed of matter and not antimatter, even though the present-day laws do not discriminate. The amount of parity violation that physicists have measured in experiments, however, is not enough to explain how the universe got so unbalanced today. We like symmetry, Dr. Kharzeev, of Brookhaven, noted, but if the symmetry between matter and antimatter had not been broken long ago, "the universe would be a very desolate place."

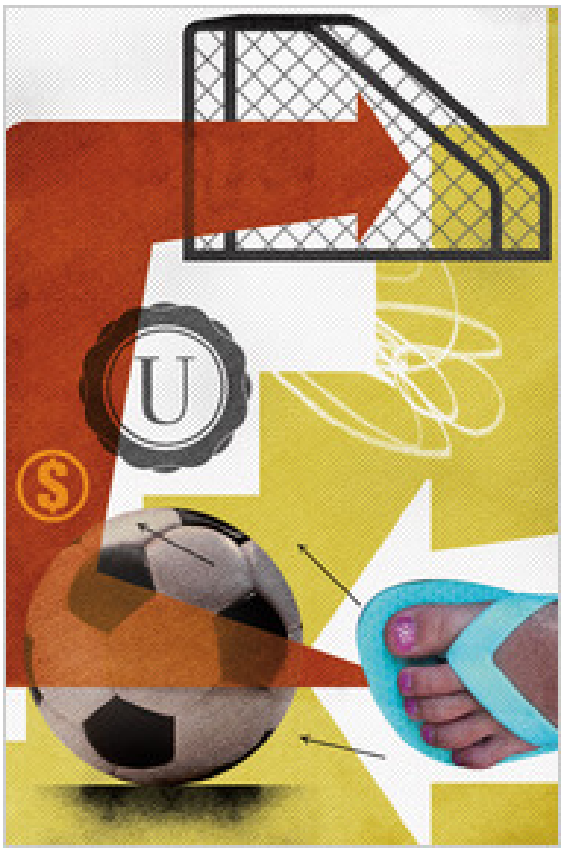
The new measurement from the quark plasma does not explain the antimatter problem either, Dr. Sandweiss said, but it helps show how departures from symmetry can appear in bubbles like the ones in RHIC in the course of cosmic evolution. Scientists think that the laws of physics went through a series of changes, or "phase transitions," like water freezing to ice, as the universe cooled during the stupendously hot early moments of the Big Bang. Symmetry-violating bubbles like those of RHIC are more likely to form during these cosmic changeovers. "If you learn more about it from this experiment, we could then illuminate the process that gives rise to these bubbles," Dr. Sandweiss said.

Dr. Vigdor said: "A lot of physics sounds like science fiction. There is a lot of speculation on what happened in the early universe. The amazing thing is that we have this chance to test any of this."

http://www.nytimes.com/2010/02/16/science/16quark.html?ref=science

As Girls Become Women, Sports Pay Dividends

By TARA PARKER-POPE



Stuart Bradford

Almost four decades after the federal education law called Title IX opened the door for girls to participate in high school and college athletics, a crucial question has remained unanswered: Do sports make a long-term difference in a woman's life?

A large body of research shows that sports are associated with all sorts of benefits, like lower teenage pregnancy rates, better grades and higher self-esteem. But until now, no one has determined whether those improvements are a direct result of athletic participation. It may be that the type of girl who is attracted to sports already has the social, personal and physical qualities — like ambition, strength and supportive parents — that will help her succeed in life.

Now, separate studies from two economists offer some answers, providing the strongest evidence yet that team sports can result in lifelong improvements to educational, work and health prospects. At a time when the first lady, Michelle Obama, has begun a nationwide campaign to improve schoolchildren's health, the lessons from Title IX show that school-based fitness efforts can have lasting effects.

Title IX of the Education Amendments of 1972 required schools and colleges receiving federal money to provide the same opportunities for girls as they did for boys. Relatively few students, male or female, participate in intercollegiate sports. But the effects in high school were remarkable. Just six years after the enactment of Title IX, the percentage of girls playing team sports had jumped sixfold, to 25 percent from about 4 percent.

Most research on Title IX has looked at national trends in girls' sports. Betsey Stevenson, an economist at the Wharton School of the University of Pennsylvania, has taken it a step further, focusing on state-by-state variations.

"I looked to see what it means to add sports to girls' lives," she said. "How does it change things for them?"

States with large boys' sports programs had to make bigger changes to achieve parity than states with smaller programs. Looking at the state-by-state statistics allowed Dr. Stevenson to narrow her focus, comparing differences in sports participation with differences in women's educational and work achievement.

So her study untangles the effects of sports participation from other confounding factors — school size, climate, social and personal differences among athletes — and comes far closer to determining a cause and effect relationship between high school sports participation and achievement later in life.

Using a complex analysis, Dr. Stevenson showed that increasing girls' sports participation had a direct effect on women's education and employment. She found that the changes set in motion by Title IX explained about 20 percent of the increase in women's education and about 40 percent of the rise in employment for 25-to-34-year-old women.

"It's not just that the people who are going to do well in life play sports, but that sports help people do better in life," she said, adding, "While I only show this for girls, it's reasonable to believe it's true for boys as well."

Another question is whether Title IX has made a difference in women's long-term health. In a carefully conducted study, Robert Kaestner, an economics professor at the University of Illinois at Chicago, compared rates of obesity and physical activity of women who had been in high school in the 1970s — as Title IX was taking effect — with similar women from earlier years. Controlling the results for other influences, like age and changing diets, Dr. Kaestner was able to tease out the effects Title IX had on women's health.

He found that the increase in girls' athletic participation caused by Title IX was associated with a 7 percent lower risk of obesity 20 to 25 years later, when women were in their late 30s and early 40s. His article was published this month in the journal Evaluation Review.

Dr. Kaestner notes that while a 7 percent decline in obesity is modest, no other public health program can claim similar success. And other studies have shown that even a small drop in weight can lower risk for diabetes and other health problems.

There is still room for improvement. Today about 1 in 3 high school girls play sports, compared with about half of all boys. And participation varies widely by state, according to Dr. Stevenson's research. Southern states like Alabama, Louisiana and Tennessee still have big gender gaps, while Northern states like Maine, Minnesota, New Hampshire, Pennsylvania and Vermont are closer to parity.

"While we have more girls than ever before, we still have far more boys playing sports than girls," said Nicole M. LaVoi, associate director of the Tucker Center for Research on Girls and Women in Sport at the University of Minnesota. "The research clearly states that when anybody, boys and girls, are physically active, they can reap developmental and health benefits. But we haven't reached equality yet."

http://well.blogs.nytimes.com/2010/02/15/as-girls-become-women-sports-pay-dividends/?ref=science

Surgery for Obese Children?

By LAURA BEIL

HOUSTON — One callous question turned Brittany Caesar into a medical pioneer: "Why do you eat so much? It's not normal."

At that moment, she was in the Campbell Middle School cafeteria, sitting down to her usual lunch: two cheeseburgers, two orders of fries and a Coke. She knew she weighed too much. Her whole family weighed too much. But her world revolved around food, and she could not imagine any other existence.

"Food was my best friend," she said. "It was always there for me." Somehow, her classmate's taunt, back in 2003, wounded her in a way the usual fat jokes never had. She fled to the bathroom and wept, vowing to lose weight. Her salvation did not arrive until more than a year later when, at age 14, doctors at Texas Children's Hospital performed a gastric bypass that left her stomach the size of an egg. On the day of surgery, she weighed 404 pounds.

Ms. Caesar, now 20 years old and 175 pounds, was the first teenager to undergo a gastric bypass at Texas Children's, but more quickly followed. Today, it maintains one of the busiest bariatric practices for adolescents in the country, performing one or two bypasses each month. Although the procedure is still considered experimental for children, it is fast becoming the next front in the battle against pediatric obesity.

"I honestly believe that in 5 to 10 years you'll see as many children getting weight-loss procedures as adults," said Dr. Evan Nadler, co-director of the Obesity Institute at Children's National Medical Center in Washington.

But many doctors say research has yet to establish whether immediate improvements from surgery justify altering a child's digestive system, probably for life.

"You don't really know what the outcome is," said Dr. Edward Livingston, chairman of gastrointestinal and endocrine surgery at the University of Texas Southwestern Medical Center at Dallas. "You talk about the benefit being that it prevents kids from terrible chronic disease later in life. But some of them are going to regain weight. Some of them are going to have long-term complications and we won't find out until later."

No one knows exactly how many adolescents are turning to surgery to get thinner. One of the few studies, published in 2007, reported that bariatric surgery in teenagers was relatively rare but rising fast: from 2000 to 2003 (the last year examined), the number of operations tripled, to about 800.

There is little reason to think the trajectory has changed. Just last month, for example, the bariatric service at Rose Medical Center in Denver opened a program for teenagers.

The manufacturer of the Lap-Band System — a popular alternative to gastric bypass — is seeking approval from the Food and Drug Administration for pediatric use. That would allow the device to be marketed directly to adolescents, and could make it easier for patients to get insurance reimbursement.

Like a tiny inner tube around a balloon, the Lap-Band cinches the top part of the stomach so it cannot hold as much food in one sitting. Gastric bypass also reduces stomach capacity, and detours food around the first part of the small intestine so less will be absorbed.

The most extensive scientific studies of both these methods in children have appeared in just the past four months, and few studies have followed patients for more than about two years after surgery. The data provide reason for both encouragement and caution. Children do tend to dramatically shed excess weight during the first year. But as with adults, the weight loss tends to slow over time, with the body mass index leveling off in Year 2 at a point that remains above normal.

One of the latest studies appeared last week in The Journal of the American Medical Association. Researchers in Australia followed 50 adolescents; half underwent an intensive, supervised program for lifestyle change, and half underwent gastric banding. After two years, those teenagers who had the surgery lost considerably more weight: 21 of 25 had lost more than half their extra body weight, compared with only 3 of the 25 who did not have it.

Other recent findings have been similar, although studies have not included comparison groups. In November, researchers from Cincinnati Children's Hospital Medical Center reported results from the largest continuing study of gastric bypass surgery in teenagers, a government-sponsored trial that includes several sites, including Houston.

Among 83 patients followed for an average of two years, the average body mass index dropped to about 40, from 60, in the six months after surgery. (To have a B.M.I. of 40, a 5-foot-4 14-year-old would weigh about 235 pounds.) After two years, the average figure still hovered around 40.

"They end up in a place that is still abnormally high, but below the danger zone," said Dr. Thomas H. Inge, director of the surgical weight loss program at Cincinnati Children's. Obese children can suffer from a long list of problems better known in adults: insulin resistance, high blood pressure, fatty liver, a thickening of the left side of the heart, and even depression.

So far, the studies have found that the body starts to repair itself as the weight falls. For example, two years after gastric bypass, the left side of the heart has started to return to normal in most adolescents, according to cardiologists at Cincinnati Children's. Research also suggested that for at least as long as the children have been followed, the procedure appeared safe, and about 85 to 90 percent of adolescents maintained their initial weight loss, Dr. Inge said.

But some physicians, including Dr. Livingston, say advocates could be drawing conclusions too early. No one can say whether the changes will translate into a health advantage later on. Dr. Livingston noted that a third of the children in the Australian gastric-banding study had to go back to the operating room over concerns about the device — and that even the children in the group that did not have surgery showed respectable improvements in blood pressure, insulin resistance and other measures. With or without surgery, he said, "both groups got better."

Nor do surgeons agree on which of the two procedures used most — banding or bypass — is more appropriate for youths. Dr. Nadler, of Children's National Medical Center, prefers banding, saying it is less radical and can be more easily undone if need be. In November, in The Journal of the American College of Surgeons, he described a study finding that among 41 teenagers followed for two years after

gastric banding, their excess body weight had dropped by about half, on average, and other measures of their health had improved.

But other surgeons were not so sure. The band is a human-made device that could be in place for a lifetime, and as such carries a risk of scarring and malfunction, said Dr. Mary L. Brandt, the pediatric surgeon who heads the Houston program. “There’s no way you can give a 70-year guarantee,” she said.

And no matter the method, researchers fear that as weight-loss surgery for teenagers becomes more popular, some doctors will operate on patients who should not have the surgery — whether tempted by a potentially lucrative market or motivated by a sincere desire to help.

Dr. Nadler says such concerns are especially potent when it comes to gastric banding, which is seemingly more benign. If the F.D.A. approves it, some doctors “might start doing it who shouldn’t be doing it” because they do not provide necessary counseling, he said. “You’re going to see the adult surgeons start to do 17- and 16-year-olds, because the surgery itself is no different from adults.”

But the patients are. They are still immature, both emotionally and physically. For most scientific studies, surgical teams require that children undergo months of counseling to make sure they understand that their digestive systems are about to change, and so must their diets — forever.

Brittany Caesar had to wait a year before the surgical team granted permission for a bypass, and Dr. Brandt estimated that her hospital has refused 9 out of every 10 requests for surgery on obese adolescents because of doubts about their ability to follow through. “If you don’t follow the rules afterward, you can die,” she said.

And Dr. Brandt worries that even if her team refuses, others will give in, especially as more parents start demanding the surgery for their children. Just last month, one mother called her office wanting a gastric band for her 8-year-old daughter.

Such requests make Dr. Brandt uneasy about the future. Some days, she says, she is appalled to be doing bariatrics at all, seeing so many children raised on foods that are calorie-rich and nutrition-poor.

“But these kids are dying,” she said. “We’ve created something in our society we have to undo.”

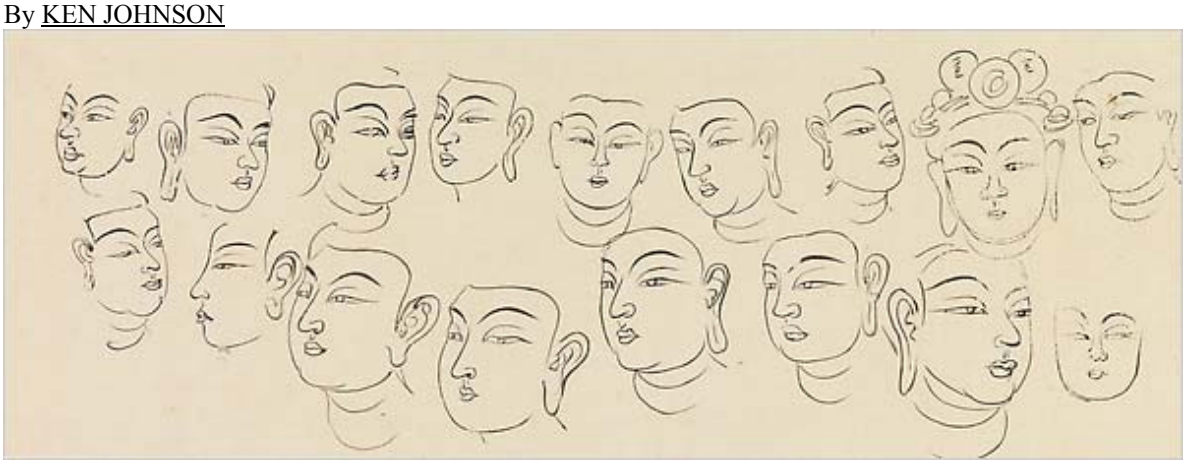
She looks to Ms. Caesar — who is dreaming of a future in nursing — and says that gastric bypass is among the most gratifying procedures she performs.

For her part, Ms. Caesar loves her smaller body, and envisions a different start for the family she hopes to have one day. “They serve Tater Tots to kids as a vegetable,” she said, shaking her head. “I’m not going to put my kids through that.”

http://www.nytimes.com/2010/02/16/health/16teen.html?ref=science

'Mastering the Art of Chinese Painting: Xie Zhiliu (1910-1997)'
Tracing the Path to Chinese Finesse

By KEN JOHNSON



Copying is bad; originality is good. That's what we learn from toddlerdom on. In art as in life, be yourself. Don't pretend. Nobody likes phonies, fakes or frauds. Forgery is illegal. Authenticity is holy.

But wait. Copying and imitating have been the rule for most of the history of human civilization. In the West artists from Raphael to Picasso have profited from copying the works of others. In art there is no such thing as pure originality.

Which brings us to a philosophically intriguing if not visually thrilling exhibition at the Metropolitan Museum of Art. "Mastering the Art of Chinese Painting: Xie Zhiliu (1910-1997)" presents more than 100 drawings and paintings by, according to wall labels, "one of modern China's leading traditional artists and a pre-eminent connoisseur of painting and calligraphy." Trained in traditional artistic methods in his youth, Xie Zhiliu (pronounced shay JER-leo) was an adviser to the Shanghai Museum and a professor of painting.

The show's first impression is not great. While Xie's drawings of birds, bees, butterflies, plum blossoms, scholars' rocks and serene landscapes exhibit a certain elegance and technical accomplishment, there is a curiously dispassionate, not to say bloodless, feeling to it. And while Xie's life spanned all but 13 years of the 20th century, there is little in his art to suggest that modern life or revolutionary developments in China affected him. The work is conservative, unimaginative and anachronistic, and it pales by comparison to the classical masters it emulates.

But it is not for artistic merit that Xie's work is on view. Maxwell K. Hearn, the exhibition's organizer and a curator of Chinese painting and calligraphy at the Met, explained in an interview that the show's main significance is in what it reveals about methods used by traditional artists. It turns out that the kind of graceful naturalism that Xie achieved in his best works came not from extensive study of nature but by tracing over and over the works of other artists on sheets of semitransparent paper.

If Xie's procedures typified the way artists had been working for centuries, as Mr. Hearn said they do, then it challenges the idea that Chinese art is as deeply grounded in real-life experience and observation of nature as is commonly believed. Copying was the royal road to aesthetic perfection.

Why, after all these centuries, is this news? Unlike in the West, Mr. Hearn said, Chinese painters did not save their preparatory studies, sketches and drawings because they did not want to reveal their trade secrets and risk demythologization of their talents. Xie was unusual in that he saved his drawings. Sarah Shay, his daughter, inherited them and recently gave the collection of more than 250 works to the Met.

"This is the smoking gun," Mr. Hearn said. He likened it to David Hockney's claim that photographic technologies like the camera obscura and the camera lucida were used as visual aids by Western artists from the Renaissance on, more extensively than art historians have heretofore been willing to admit.

Whether this will rock the world of Chinese art scholarship, only an expert could say. For the rest of us, to properly grasp what's at stake requires looking in a different way than we are accustomed to in the modern West. That is, you don't look for strikingly novel or idiosyncratic images or compositions. You focus, rather, on the more or less refined execution of familiar conventions.

Repeatedly tracing the works of old masters as Xie did might be compared to a pianist practicing a composition by Bach. This may sound suffocating for a modern artist, but it is not unlike how many young artists learn to draw: by copying their favorite comic-book characters over and over. Western contemporary artists imitate themselves too. See, for example, the many targets and American flags that Jasper Johns has painted.

In the Met show you can see different mimetic approaches Xie employed. He traced from drawing instruction books and reproductions of old masterworks. There are relatively finished pictures of ducks and a goose, and there are pages on which a single small bird is rendered numerous times with slight variations and increasing degrees of subtlety and detail. As the show progresses, you see how he took on larger and more complex compositions and was able to work from real old master drawings and paintings.

Using pictures by others freed Xie from worry about creating his own compositions, Mr. Hearn explained, and enabled him to focus entirely on line quality like a calligrapher, which, in fact, he was. In one large piece copied from a painting by Chen Hongshou (1599-1652) you see how Xie plays with different kinds of line. He outlines a scholar's rock in the foreground with a dark, thick black line; limns reedy plants with razor-sharp fine lines; and renders a perched bird with feathery strokes that make it seem almost weightless. He's not becoming more sensitive to nature; he's learning graphic formulas.

The exhibition does include drawings directly from nature: pictures of plants, birds and landscapes and, most notably, a double portrait of a bumble bee. Xie traced and retraced his own drawings too, aiming not at raw realism but at developing a lexicon or visual vocabulary of standard motifs from which to construct larger pictures and paintings.

It's ultimately hard to say how good a painter Xie is. Two or three of his finished paintings of birds on gnarly branches (one in the form of a high-quality photographic facsimile that will be replaced by the real thing when it arrives from Shanghai) suggest that he was a skillful producer of faux-antique decorations for the homes of the privileged. His late nature drawings appear to be the creations of a devoted amateur. Absent more compelling evidence of artistic achievement, the value of his work remains more forensic than aesthetic.

"Mastering the Art of Chinese Painting: Xie Zhiliu (1910-1997)" remains on view through July 25 at the Metropolitan Museum of Art; (212) 535-7710, metmuseum.org.

http://www.nytimes.com/2010/02/15/arts/design/15painting.html?ref=design

Quirky Marriage of Art and Text

By BENJAMIN GENOCCHIO

Right by the train station in Croton Falls is an old factory that once serviced forklifts and trucks. Today it houses artists' studios and an exhibition space — not so much a gallery as a place where artists and independent curators can put up temporary exhibits. It is called Lift Trucks Project.

Not surprisingly, the exhibitions here tend to be somewhat out of the ordinary. That is the way the artist Tom Christopher, who owns the space, wants it. His goal, he said, is not to sell artwork to promote the creators' careers but to "encourage people to look at art from a fresh perspective."

The latest project is " 'Ek-fre-ses," a group show of quasi collaborations among some 35 artists and writers. "Ekphrasis," as it is written in English, is a verbal representation of a visual work of art that dates to ancient Greece. Each work in the show is paired with a text, sometimes old, sometimes commissioned especially for the exhibition and published in the catalog. Over all, the quality of the writing is extremely good.

Snippets of the text have also been excerpted from the catalog, blown up, printed out on giant sheets of paper and used to frame or wrap or in some way become part of each piece of art on the wall. It doesn't really work, for the partial text becomes meaningless and more often than not distracts from the art.

Putting aside this quirk of display, the show is filled with interesting if disparate stuff. You will find everything here from an Auguste Rodin watercolor to a print by Robert Motherwell. There are even a pair of LeRoy Neiman sketches from the 1960s, borrowed from Mr. Christopher's extended family.

But the show mostly contains work by Mr. Christopher's friends and acquaintances, people he knew as a successful young painter in the East Village in the 1980s and, later, in Long Island City, Queens. Among them are a conceptual artist known only as FA-Q and Doug McQueen, a tattoo artist who also paints and draws.

Because the show has no real theme, it is best approached as a series of individual artist-writer collaborations. Some pairings are more successful than others: For instance, the playwright and art dealer James Balestrieri wrote a poignant prose poem to accompany a 1931 lithograph by Rockwell Kent.

Ben Cheever, the son of the novelist and short story writer John Cheever, and an author in his own right, wrote a short but jaunty text loosely inspired by a Saul Steinberg watercolor, borrowed from a local collector. It recalls his childhood memories of Steinberg's magazine illustrations and what they meant to him.

Beyond famous names, and solid career painters like Mike Cockrill and A. R. Penck, the show includes some weird underground artists. Among the strangest is Dainty Dotty, a mid-20th-century American circus "fat lady" (she was 585 pounds) who also made gothic, surrealistic watercolors.

Other oddities include cowboy paintings from the 1940s by Fred Darge, an amateur artist, retablos from Mexico, and some lime green gnome sculptures by the German artist Ottmar Hörl. Mr. Hörl's gnomes inspired the writer James P. Othmer to pen an imaginary conversation between the ghosts of Adolf Hitler and Joseph Goebbels about the artist and his work. It is one of the nuttiest things you will ever read.

" 'Ek-fre-ses," Lift Trucks Project, 3 East Cross Street, Croton Falls, through March 27. Information: ltproject.com.

http://www.nytimes.com/2010/02/14/nyregion/14gallerywe.html?ref=design

Works That Testify to the Nurturing of Black Artists

By BENJAMIN GENOCCHIO

At its most creative and inspired, philanthropy can alter lives, or even a society. That is the message of "A Force for Change: African American Art and the Julius Rosenwald Fund," a thoughtful show at the Montclair Art Museum.

The Rosenwald Fund was a philanthropic organization created in 1917 by the Chicago businessman Julius Rosenwald (1862-1932), who made a fortune as the part owner, president and chief executive of Sears, Roebuck & Company. His philanthropy supported the building of more than 5,000 schools for black students in the South and gave stipends to hundreds of black artists, writers, teachers and scholars.

The current exhibition, which originated last year at the Spertus Museum in Chicago, presents around 60 paintings, sculptures, photographs and works on paper by 22 Rosenwald fellows, who included such notable artists as Gordon Parks, Jacob Lawrence and Elizabeth Catlett. Most, but not all, of the artists are black; the program also offered fellowships to white Southerners with an interest in and concern for race relations.

The art on view dates from roughly the late 1920s to the late 1940s, a period when the fund was active as a grant-making body under the leadership of Edwin Rogers Embree. Mr. Rosenwald, whose philanthropy was influenced by Emil G. Hirsch, a Chicago rabbi, and Booker T. Washington, believed that charities should devote their entire resources to addressing an immediate cause. The fund was devised to spend itself out of existence within 25 years of his death, and it officially closed in 1948.

The show is arranged mostly according to the order in which artists received fellowships, beginning with Augusta Savage, a talented but not particularly well known sculptor, teacher and activist associated with the Harlem Renaissance. She was the first visual artist to get a fellowship, which enabled her to study in Europe. "Gamin" (circa 1929), a realistic, painted plaster portrait of a black street child, was produced shortly before she left for France.

Many of the artists in this show broach social themes in their work. Charles Alston made evocative pictures of farm life and poverty in the South, like "Farm Boy," showing here, an affecting portrait done in 1941, during his fellowship. It is painted in a realistic style that owes much to the work of the regionalist artists John Steuart Curry and Thomas Hart Benton.

"Farm Boy" won a purchase prize at the first annual Exhibition of Paintings, Sculptures and Prints by Negro Artists of America at Atlanta University in 1942. It is one of the better paintings in the show, along with "Harriet Tubman" (1931), an expansive, sensual mural painted in a flat, simplified style by Aaron Douglas, who got a fellowship in 1937 to travel in the South and in Haiti. The work shows Tubman, the antislavery activist, breaking the shackles of bondage.

Though "Harriet Tubman" predates the fellowship period, it was commissioned by Mr. Rosenwald's son-in-law, Alfred K. Stern, according to the exhibition catalog, which cites an article in the N.A.A.C.P. magazine The Crisis. Insofar as the mural emphasizes heroes and heroines of black history, it is also typical of a lot of work in this exhibition. Several linoleum cuts from the Negro Woman series by Ms. Catlett depict extraordinary women like Tubman and Phillis Wheatley, one of the first black poets to be published in America.

Lamar Baker and Robert Gwathmey were two Southern white artists who received fellowships, in 1942 and 1944, respectively. Though neither was very talented, in my opinion, they shared an awareness of and sensitivity toward the cultural and historical roots of the black experience in America; Mr. Gwathmey painted images of black musicians in a style borrowed from Picasso, while Mr. Baker, a painter and printmaker, often dealt with the legacy of slavery.

Three early photographs by Mr. Parks, including perhaps his most famous image, "American Gothic, Washington D.C." (1942), produced during the year of his fellowship, attest to the importance of Mr. Rosenwald's bold and creative philanthropy. Produced when the artist was unknown, it shows a black cleaning woman posed before an American flag with a broom and a mop.

There are other interesting things here worth lingering over, including half a dozen Jacob Lawrence prints and some modernist works by Ronald Joseph and Charles Sebree.

Not all these artists went on to have successful careers, but that seems beside the point. Their work promoted new images of black Americans and challenged accepted, often racist notions of black creativity.

"A Force for Change: African American Art and the Julius Rosenwald Fund," Montclair Art Museum, 3 South Mountain Avenue, Montclair, through July 25. Information: (973) 746-5555 or montclairartmuseum.org.

http://www.nytimes.com/2010/02/14/nyregion/14artsnj.html?ref=design

Post-Minimal to the Max

By ROBERTA SMITH

TO paraphrase Jerry Lee Lewis, there is a whole lot of art making going on right now. All different kinds. But you'd hardly know it from the contemporary art that New York's major museums have been serving up lately, and particularly this season. The current exhibition of Gabriel Orozco at the Museum of Modern Art along with the recent ones of Roni Horn at the Whitney Museum and of Urs Fischer at the New Museum have generated a lot of comment pro and con. So has the Tino Sehgal performance exhibition now on view in an otherwise emptied-out Guggenheim rotunda. But regardless of what you think about these artists individually, their shows share a visual austerity and coolness of temperature that are dispiritingly one-note. After encountering so many bare walls and open spaces, after examining so many amalgams of photography, altered objects, seductive materials and Conceptual puzzles awaiting deciphering, I started to feel as if it were all part of a big-box chain featuring only one brand.

The goal in organizing museum exhibitions, as in collecting, running a gallery and — to cite the most obvious example — being an artist, should be individuation and difference, finding a voice of your own. Instead we're getting example after example of squeaky-clean, well-made, intellectually decorous takes on that unruly early '70s mix of Conceptual, Process, Performance, installation and language-based art that is most associated with the label Post-Minimalism. Either that or we're getting exhibitions of the movement's most revered founding fathers: since 2005, for example, the Whitney has mounted exhibitions of Robert Smithson, Lawrence Weiner, Gordon Matta-Clark and Dan Graham. I liked these shows, but that's not the point. We cannot live by the de-materialization — or the slick re-materialization — of the art object alone.

After 40 years in which we've come to understand that dominant styles like Abstract Expressionism, Minimalism and Pop are at best gross simplifications of their periods, it often feels as though an agreed-upon master narrative is back in place.What's missing is art that seems made by one person out of intense personal necessity, often by hand. A lot but not all of this kind of work is painting, which seems to be becoming the art medium that dare not speak its name where museums are concerned.

Why hasn't there been a major New York show of Philip Taaffe, whose layered, richly colored paintings are actually taking the medium of painting in a direction it hasn't been before? Why has a retrospective of the painter Chris Ofili — with his volatile mix of color, pattern, popular culture and identity politics — opened at the Tate Britain but not yet been scheduled for a New York museum? And why not see what a survey of the work of an artist as endlessly varied and yet dauntingly consistent as Joe Zucker — a veteran of the Post-Minimalist outfield — might look like? If the public can handle an empty museum as

art, it can deal with some paintings made of cotton balls. I, for one, would rather see a tightly organized overview of Mr. Zucker's work than Marlene Dumas's warmed-over Expressionism, which was recently displayed in bulk at the Museum of Modern Art. How did we get to this point? In the 1970's the Whitney used to be committed to showing artists from across the United States; they were called regional artists in those days. That term has thankfully fallen out of fashion, but the artists have all but disappeared from museum walls. The Modern, for its part, used to present several works each by 10 to 15 artists under the rubric of its "Americans" show.

But a combination of forces threatens to herd all of our major art institutions into the same aesthetic pen. The need to raise and make money sends curators hunting for artists with international star power who work big at least some of the time, deploy multiple entertaining mediums and make for good ad campaigns (like the self-portrait featured in the MoMA ads for its coming exhibition of William Kentridge). The small show devoted to an artist who doesn't have an immense reputation and worldwide market becomes rarer and rarer.

The consistent exposure to the big-statement solo exhibition becomes self-perpetuating, as these shows condition not only curators but the public to expect more of the same. I realize to my horror, for example, that the idea of seeing a survey of contemporary painting at the Modern makes me squirm. It would look — I don't know — too messy and emotional, too flat, too un-MoMA.

The New Museum is a notable exception to all this. Compared with other museums in town, it deserves credit for trying to sum up recent trends outside latter-day Post-Minimalism. "Unmonumental," its inaugural exhibition in its new building, explored recent developments in collage and assemblage, while "After Nature" plunged into a range of mediums in pursuit of a humanistic theme. Both shows sprawled to the point of incoherence but were still ambitious attempts to account for swaths of contemporary art.

The Guggenheim doesn't play it as safe as the Modern or the Whitney. With its Sehgal show, as with its "Theanyspacewhatever" exhibition in 2008, it acts like a place where anything can happen. But shows where we encounter an artist's single-minded, highly personal pursuit that proceeds one object at a time tend to feature past masters. The Guggenheim's recent, fantastic Kandinsky exhibition was an example (as was the Modern's Ensor show). Yet there are plenty of artists working this way now. They may not be making history (or entertainment, either), but they are still making really good art whose very unfolding has its own integrity and is exciting to see.

I wouldn't have a problem with these shows of the gods and godlings of Post-Minimalism if they were balanced and mixed with other stuff that is completely different. But that other stuff is largely missing in New York museums, though there is plenty of it around.

It is amazing that some aspect of Laura Owens's or Dana Schutz's work is not thought worth some kind of small, well-organized museum show. The same goes for Lari Pittman, who could sustain something larger. European artists, who bring a little more wit and accessibility to Post-Minimalism, include Rosemarie Trockel and Fischli & Weiss. Someone should do a show of the early paintings of Peter Doig.

And there is more demolition work to be done on the master narratives of the recent past. It would be interesting to see how the eccentric California painter Roy De Forest holds up, what with the several returns of representation and of painting since he emerged. Similarly, the midcentury West Coast painter David Park — more than Richard Diebenkorn — could do with another New York retrospective. He's the kind of artist who can light a fire under a young artist and also teach the public a great deal about looking at painting, a skill we seem to be in danger of losing. The paintings of John Wesley, an elder statesman of alternative Pop Art, were seen in quantity at the Venice Biennale; he had a retrospective at P.S. 1 in 2000 but has never had a show of any size in a Manhattan museum. Other deserving painters who emerged in the 1940s and 1950s, often working small and usually beyond the pale of Abstract Expressionism, include Alice Trumbull Mason, Beauford Delaney, Steve Wheeler, Loren MacIver and Lois Dodd — who, by the way, is still making art.

You'd never know from looking at museums that figurative painting, running the gamut from realist to quasi-expressionist, is on the rise. (Speaking of which, if some New York curator didn't see Nicole Eisenman's recent show at Leo Koenig and at least consider doing a show, we are in trouble.) Some kind of local museum attention could be given to the realist painter Rackstraw Downes, the abstract painters Thomas Nozkowski, Larry Poons and Stanley Whitney, or to an artist like Dona Nelson, who refuses to commit to either camp and whose eccentricities are a good match for Joe Zucker's. These painters seem slated to become the forgotten artists of the future. David Bates is having a perfectly interesting career without any attention from the New York art establishment, thank you very much.

New York missed out on a recent retrospective of the cantankerous political surrealist Peter Saul. A survey of the work of the painter Jim Nutt — our era's crazed answer to the Northern Renaissance — being organized by the Museum of Contemporary Art in Chicago, does not yet have a New York stop. And it has finally been determined that the long overdue survey of the abstract ceramicist Ken Price that has been undertaken by the Los Angeles County Museum of Art will come to the Metropolitan Museum. I'm glad it will be seen here, but the fact that the Guggenheim, the Whitney and the Modern could not fit it into their schedules shows an appalling narrowness of vision. I don't care how many scheduling conflicts can be cited.

If this sounds harsh, let me also say that I think curators of contemporary art in New York museums have some of the toughest jobs in the art world. They rarely seem able to act on their own without some kind of committee oversight and are under unbelievable pressure to succeed at the box office. Museum gallery space is at a premium and is almost uniformly unforgiving. Excepting the idiosyncratic flexibility of the Guggenheim's ramp, there is barely a decent gallery among our main museums, although we seem to have stopped talking about the effect this has on curators, their exhibitions and thus on the seeing and comprehending of art.

New York museum curators also have to compete with New York galleries, which are out there discovering new and overlooked artists and — increasingly — mounting invaluable historical shows. At the same time the amount of inspiration and information curators can gain from galleries is unparalleled. However, gathering it requires spending more time seeing shows beyond the six or eight galleries whose artists get most of the big museum shows these days. The idea that a moment's most visible artists are concentrated in a handful of powerful galleries is only superficially true. By now we know too much not to willfully work against this notion.

Museum curators need to think less about an artist's career, its breakthroughs and its place in the big picture and more in terms of an artist's life's work pursued over time with increasing concentration and singularity.

They have a responsibility to their public and to history to be more ecumenical, to do things that seem to come from left field. They owe it to the public to present a balanced menu that involves painting as well as video and photography and sculpture. They need to think outside the hive-mind, both distancing themselves from their personal feelings to consider what's being wrongly omitted and tapping into their own subjectivity to show us what they really love.

These things should be understood by now: The present is diverse beyond knowing, history is never completely on anyone's side, and what we ignore today will be excavated later and held against us the way we hold previous oversights against past generations.

Message to curators: Whatever you're doing right now, do something else next.

http://www.nytimes.com/2010/02/14/arts/design/14curators.html?ref=design

See It, Feel It, Touch It, Climb It

By CAROL VOGEL

In the 12 years that the Metropolitan Museum of Art has presented exhibitions on its roof, visitors have seen sculptures by Jeff Koons, Ellsworth Kelly, Roy Lichtenstein and Roxy Paine. They have glimpsed more unusual projects too, like miniature black smoke shells that resembled inkblots bursting into the sky every afternoon, the work of the Chinese artist Cai Guo-Qiang. Now for the 13th installation, Gary Tinterow, the Met's curator of 19th-century, Modern and contemporary art, has decided to try something more ambitious.

From April 27 through Oct. 31 the twin artists Mike and Doug Starn will be creating a site-specific installation that is part sculpture, part architecture and part performance. Called "Big Bambú" it will be a monumental bamboo structure in the form of a cresting wave rising as high as 50 feet above the roof. Throughout the summer the artists and a team of rock climbers will lash together an intricate network of 3,200 interlocking bamboo poles with nylon rope, creating on the roof's floor labyrinthlike spaces through which visitors can walk.

"Big Bambú" is a perpetual work in progress — it will never quite be finished — that will evolve in three phases: first, the basic structure will be completed by the opening day; second, the eastern part will be built by the artists and rock climbers to a height of about 50 feet; third, the team will build the western part to about 40 feet high. Not only will visitors be able to watch the installation as it is constructed and walk through it, they will also be able to climb up the sides.

The project is similar to one the artists did in 2008 in a factory space in Beacon, N.Y. "When I saw it in Beacon I thought how great it could be for the roof," Mr. Tinterow said. So for the last five months he and the artists have been working on a plan to adapt the idea for the Met.

"It's our largest, most complicated endeavor and the only one that invites the public to participate," he said.

While anyone will be able to experience the project from the roof garden, timed tickets will be required for those who want to explore the upper regions of the installation, with trained guides leading groups of up to 15 visitors. "We have been working with the building department to conform to the proper safety standards," Mr. Tinterow said. There will be lockers for belongings because, he explained, visitors must have their hands totally free while climbing.

JEWISH MUSEUM BUYS A VUILLARD

The Jewish Museum in New York went shopping in London last week, where it bought a 1913 painting by Vuillard at Christie's.

"Lucie Hessel Lisant" (Lucie Hessel Reading) is an intimate scene of the artist's muse at a table in her bedroom. A mirror in the background reflects an outdoor scene, making it a picture within a picture.

Lucie Hessel was the wife of Jos Hessel, the original owner of the painting and one of Vuillard's dealers. The painting is the first by the artist to enter the museum's collection, sealing a gap that curators there say they have been hoping to fill for years.

"The Jewish Museum has always been interested in the patrons of politics in 19th-century and early-20th-century France, and Vuillard has always been of great interest because of his closeness to Jewish patrons like the Hessels," said Norman Kleeblatt, the museum's chief curator. "And Mrs. Hessel is fascinating. She's the most often depicted of Vuillard's muses."

The museum paid $464,430 for the painting, well above its $288,554 high estimate. The money was provided by a patron who wishes to remain anonymous. Mr. Kleeblatt called the donation "a rare opportunity" at a time "when things are tight."

SCHOLARS' OBJECTS SALE

Most Chinese scholars' objects are no bigger than a bread box. After all, these high-quality, sophisticated pieces, sometimes functional and sometimes inspirational, were meant to adorn a desk or study. But if you've been acquiring them for more than 30 years, as Robert H. Blumenfield has, the cumulative effect can overwhelm even the most ardent collectors.

"My house was becoming crazy, and my wife was on my back," said Mr. Blumenfield, a Los Angeles real estate developer and author of "Blanc de Chine: The Great Porcelain of Dehua." "I have collections within collections. I'm a bit manic about it."

Since Mr. Blumenfield said he had no intention of curtailing his collecting, something had to give. So he has reluctantly agreed to part with a selection of his scholars' objects — 158 to be exact — which Christie's will sell in New York on March 25. The sale is timed to Asia Week, when leading collectors of Asian art descend on New York for auctions, art fairs and gallery exhibitions.

The Blumenfield auction will include a range of rhinoceros-horn-and-ivory carvings, paintings and other works of art dating from the 15th to the 19th centuries. Among the highlights is a 17th-century rhinoceros-horn cup carved with a scene of the poet Tao Yuanming set among bamboo and rocks. It is estimated at $200,000 to $300,000. Also for sale is an 18th-century imperial Songhua stone box and cover that is expected to bring $250,000 to $280,000.

"This is only about 15 percent of my collection," Mr. Blumenfield said. "It's very Chinese in taste." Although he had thought of selling the works in Hong Kong, in the end he chose New York. "Everything has changed since the Internet," he said. "Now it doesn't matter."

GWANGJU BIENNALE

Details are slowly beginning to emerge about the eighth Gwangju Biennale, which opens in that industrial South Korean city in September. Although the list of 100 artists whose work will be on view won't be released until April, Massimiliano Gioni, its artistic director, has announced the biennale's title: "10,000 Lives."

"I'm asking the question, what is the role of artists in our image-polluted society?" Mr. Gioni said. "The biennale will explore the relationships that bind people to images and images to people."

The title is taken from "Maninbo" ("Ten Thousand Lives"), an unfinished multivolume poem by Ko Un, a dissident poet. He was accused of treason and held in solitary confinement in 1980 for his participation in the South Korean democratic movement. (He was later pardoned). While imprisoned, he started writing a poem describing every single person he had met in his life.

Mr. Gioni said that unlike most biennales, which focus primarily on contemporary art, his will include work from the early 20th century on. And not everything was meant to be art, per se. There will also be found objects, some photographs, some salvaged artifacts.

"I'm trying to look at images across time," he said.

http://www.nytimes.com/2010/02/12/arts/design/12vogel.html?ref=design

Miroslav Tichy
An Ogling Subversive With a Homemade Camera

By KAREN ROSENBERG

The photographs are blurry, skewed, badly printed and in terrible condition: dog-eared, scratched, spotted and encrusted with who knows what. They all show girls and young women, in streets and public parks, going about their business and mostly unaware of the camera.

Whose work is this, with its peculiar echoes of Gerhard Richter, Richard Prince, Ron Galella, Garry Winogrand and Humbert Humbert? It's the private archive of Miroslav Tichy, a Czech who took the pictures during the 1960s and '70s in his hometown, Kyjov, and now has a solo show at the International Center of Photography.

Mr. Tichy, now in his 80s, was merely a local curiosity until the eminent curator Harald Szeemann included an exhibition of his photographs in the 2004 Seville Biennial. That presentation won the New Discovery Award, and the Tichy Ocean Foundation was established on the his behalf. The photography center's show, "Miroslav Tichy," is his first at an American museum, and while it's mildly disturbing, it's also intensely fascinating.

The exhibition, organized by the center's chief curator, Brian Wallis, includes some 100 mostly unique prints, as well as homemade cameras and other crumbling ephemera from Mr. Tichy's house in Kyjov. The museum is also screening "Tarzan Retired," a 35-minute film from 2004 by Mr. Tichy's longtime neighbor and biographer, Roman Buxbaum.

You might call Mr. Tichy (pronounced TEE-kee) an outsider artist if it weren't for the inconvenient fact that he studied at the Academy of Fine Arts in Prague and was for a time a celebrated painter. His photographs may look naïve, but they're the product of a carefully orchestrated series of missteps that begins with crude, homemade cameras. As he says in the film, "If you want to be famous, you must do something more badly than anybody in the entire world."

His photography is also much more subversive than Westerners might perceive. It exemplifies the nonviolent dissent perfected by Czech students and artists during and after the Soviet invasion of 1968, when the nurturing Prague Spring was followed by a crackdown on free expression.

Mr. Tichy was marked from the beginning: he was a nonconformist with a history of mental illness, and a former member of the Brno Five, a group of painters who broke with the state-sanctioned Socialist Realism of the postwar years. He was monitored and, from time to time, institutionalized.

He did not take up photography until the late 1950s. (All of his pictures are untitled and undated; those in the show are thought to have been made between 1965 and 1980.) When he did, he quickly moved from nostalgic landscapes in the style of Josef Sudek to his fleeting portraits of the women of Kyjov.Allowing himself three rolls of film a day, he wandered the streets performing his own personal version of the Czech government's surveillance program. He was a stalker of pretty girls with a secret agenda.

Clearly Mr. Tichy admired legs, and backsides, often cropping the image to show just the lower body. But he did more than ogle. Many photographs show conspiratorial pairs of women: gossiping, telling secrets or otherwise staking out bits of privacy in public.He seems to have been tolerated as the town eccentric, alarming in habits (daily visits to photograph at the local pool) and appearance (an unkempt beard and ratty sweater) but harmless enough. In one memorable shot two seated girls confront the camera with disdain, as if to say, "There's that creepy old guy again."

As Mr. Buxbaum's film reveals, some of Mr. Tichy's subjects assumed that his camera was fake. The cameras certainly don't look functional; he fashioned them from shoeboxes, toilet-paper rolls and plexiglass, polishing the lenses with toothpaste and cigarette ash. You can see some of these misbegotten objects in two vitrines, along with stacks of tattered prints.

The photographs' condition can be troubling: it suggests not just carelessness, but mental decay and even the degradation and defilement of women. Mr. Tichy is known to have encouraged visitors to drop his prints on the floor and step on them.Yet he also adorned many of them with elaborate hand-drawn frames, a devotional touch that evokes cartes de visites and other early, personal forms of photography. The wiggly lines around one shot of a bare-chested woman make her look like Edvard Munch's "Madonna." Sometimes he also drew directly on the prints, reinforcing the figure's contours with faint pencil lines.

Elsewhere Mr. Tichy pursued streamlined, modern compositions, as when he photographed groups of bathers at Kyjov's public pool, playing up the graphic shapes of the swimsuits and the park's gridded white fence.

To a viewer schooled in contemporary art Mr. Tichy's prints look like Mr. Richter's early black-and-white photo-paintings translated back into the medium of photography. In "Tarzan Retired," Mr. Szeemann points to a Tichy print and chuckles, "This is a good 'Richter.' "

Mr. Tichy certainly has much in common with Mr. Richter: a background in Socialist Realism, a compulsion to archive and a determination to thwart photography's material limits. But Mr. Tichy's private archive of Eastern Bloc beauties also recalls the all-American women Mr. Prince appropriated from magazines and publicity shots.Mr. Prince wrote an essay for the catalog. In his signature smart-alecky, red-blooded-male persona, he links Mr. Tichy to Bettie Page, Swanson's TV dinners and the short stories of John Cheever.

In Mr. Wallis's descriptions Mr. Tichy is a Baudelairean flâneur who thrives on chance encounters in the city, and an anti-modernist who reverses centuries of photographic progress. This portrayal sanitizes Mr. Tichy, who can come across initially as a lecherous old coot.There's truth in all of these interpretations, but no single one quite captures the photographs' uncanny fusion of eroticism, paranoia and deliberation.

"Miroslav Tichy" continues through May 9 at the International Center of Photography, 1133 Avenue of the Americas, at 43rd Street; (212) 857-0000, icp.org.

http://www.nytimes.com/2010/02/12/arts/design/12photos.html?ref=design

Freeze-Frame Flamenco Hints at the Mystique of a Fast, Fiery World

By ALASTAIR MACAULAY

In time for New York's annual Flamenco Festival, which starts on Thursday, an exhibition has just opened, split between two places. It shows flamenco in photographs, some of them dating to the 19th century.

There is little to distinguish tone and content between the show at the Aperture Gallery in Chelsea and that at the Amster Yard Gallery at Instituto Cervantes in Turtle Bay; it's best to see them in quick succession. The overall title is "No Singing Allowed: Flamenco and Photography" (although, when I visited the Aperture Gallery, some old flamenco recordings could be heard in the background — I thought I recognized the voice of La Niña de los Peines, the most enthralling of all flamenco singers on record). The curator is José Lebrero.

These photographs reminded me why many dance critics dread reviewing flamenco. For despite its costumes and its gestures, it is not really a pictorial art. Its dancing is largely percussive, and its rhythms are complex. And so to look at the dozens of photographs in either gallery proves strange: interesting, atmospheric and yet largely peripheral to the art itself.

Only a handful contain any serious dance information. An Ibáñez photo shows how Juan Morilla, poised on half-toe, holds a classic flamenco arc from hands to heel, like a bow bent. A 1995 picture by Sophie Elbaz, capturing Adelina Carvajal in rehearsal for the Dance of Fire, perfectly illustrates the remarkable degree to which the dancer pulls her arms and shoulders back (far more than is ever approved in ballet) and arches her spine while raising those arms in a halo above (and behind) the head. The dancer La Golondrina is caught by Inge Morath in a dramatic backbend on the floor; I have yet to see any flamenco dancer try this in performance.

"Gypsy Dancing," a dim sepia 1901 photograph by the painter Pierre Bonnard — remarkable just because of who took the picture — catches the easy arc of a dancer's arm. One taken by Paul Haviland in New

York in 1909 (in Clarence H. White's atelier) shows the dancer Faico, his knees slightly bent, his arms holding opposite curves.

The work of celebrated photographers can be seen here — Adolphe de Meyer, Man Ray, Cartier-Bresson, Brassaï — but it's evident that they were not looking for the qualities that make a flamenco dancer or musician remarkable. Brassaï's series of 1951 photographs "The Seville Fair" includes a vivid glimpse of women sewing dresses; the Cartier-Bresson, taken in Turkey, is of one man's gesture, not apparently flamenco. The photographs by Carlos Saura, like his flamenco films, are too arty for my taste to be persuasive, but it's interesting to observe his view of María Pagés (who dances this weekend at City Center) silhouetted against a doorway that looks almost like a Mondrian.

A degree of name-dropping develops. Here, in one photograph, are Picasso and Jean Cocteau, reportedly at a bullfight, and in another picture, Salvador Dalí. There are John Lennon in tight trousers giving his idea of a flamenco move to the other Beatles; Leni Riefenstahl in Gypsy attire in her film "Tiefland"; and Jean Renoir holding a pose that could be attached to many nations other than Spain. We see flamenco-based activities, like Diaghilev's Ballets Russes in Massine's Spanish ballet "Le Tricorne."

But an aspect of sociology also emerges; you can sense the tight, communal involvement among musicians, observers and dancers. Here also is teaching, most strikingly as El Farruco watches a boy as he dances in the street, in a picture from about 1964. Two girls are seen performing at an American military base in Spain in 1959, but the young men aren't really looking. An American sailor is shown at night before a wall in Barcelona plastered with posters for local dance shows.

Some of the most famous flamenco artists are shown, but seldom in performance: postcards of Pastor Imperio in repose; close-ups of Carmen Amaya's hands (even in death). It's good to see photos of La Argentina, showing both rows of teeth in her eager grin and swirling her skirts. The men include the long-haired Joaquín Cortés (famous for his bad-boy sexiness) and Israel Galván (who performs in this year's festival, and is said to be ridding flamenco of its clichés). Little of their artistry can be discerned on the walls, and little of the Gypsy life that underlies this genre. But you see flamenco both as a source of pride and as a claim to fame.

"No Singing Allowed: Flamenco and Photography" continues through April 1 at Aperture Gallery and Bookstore, 547 West 27th Street, fourth floor, Chelsea, (212) 505-5555 or aperture.org; and at Amster Yard Gallery at Instituto Cervantes, 211 East 49th Street, Manhattan, (212) 308-7720 or nuevayork.cervantes.es.

An earlier version of this article incorrectly listed the Web address of Instituto Cervantes as nuevayorkcervantes.es.

http://www.nytimes.com/2010/02/10/arts/dance/10aperture.html?ref=design

Tiger's ancient ancestry revealed

By Matt Walker
Editor, Earth News

The tiger may be more ancient and distinct than we thought.

Tigers are less closely related to lions, leopards and jaguars than these other big cats are to each other, according to a new comprehensive study.

The genetic analysis also reveals the tiger began evolving 3.2 million years ago, and its closest living relative is the equally endangered snow leopard.

The discovery comes as the BBC launches a collection of intimate videos of wild tigers and the threats they face.

Despite the popularity and endangered status of tigers, much remains to be discovered about them, including how they evolved.

It has long been known that the five species of big cat - the tiger, lion, leopard, jaguar and snow leopard, which belong to the *Panthera* genus - and the two species of clouded leopard are more closely related to each other than to other smaller cats.

But it has been difficult to pin down the exact relationships between them.

So to find out more, scientists Mr Brian Davis, Dr Gang Li and Professor William Murphy conducted an analysis of the DNA of all these species.

By looking at similarities in DNA held in mitochondria and within the sex chromosomes among other places, the researchers found that the five big cat species are related to each other in a different way to previously thought.

Their data strongly suggests that lions, leopards and jaguars are most closely related to each other.

Their ancestor split from other cats around 4.3 to 3.8 million years ago.

About 3.6 to 2.5 million years ago, the jaguar began to evolve, while lions and leopards split from one other about 3.1 to 1.95 million years ago.

But the tiger had already emerged by this point.

The ancestor of tigers and snow leopards also branched off around 3.9 million years ago.

The tiger then began to evolve into a unique species toward the end of the Pliocene epoch, about 3.2 million years ago.

That makes the tiger and snow leopard "sister species", the researchers report in the journal Molecular Phylogenetics and Evolution.

Both tigers and snow leopards are among the world's most endangered big cats.

Fewer than 3500 tigers are thought to survive in the wild.

One subspecies, the Sumatran tiger, is so enigmatic that the first film of a wild individual was only recorded this year, and Indonesia is considering entrusting them to private individuals for safe-keeping.

Last year, a study revealed that the largest sub species, the Amur tiger, may be on the genetic brink, as so few individuals remain.

Story from BBC NEWS:
http://news.bbc.co.uk/go/pr/fr/-/earth/hi/earth_news/newsid_8512000/8512455.stm

Published: 2010/02/12 14:24:50 GMT

Grandparents 'boost obesity risk'

By Emma Wilkinson
Health reporter, BBC News

Young children who are regularly looked after by their grandparents have an increased risk of being overweight, an extensive British study has suggested.

Analysis of 12,000 three-year olds suggested the risk was 34% higher if grandparents cared for them full time.

Children who went to nursery or had a childminder had no increased risk of weight problems, the International Journal of Obesity reported.

Nearly a quarter of preschool children in the UK are overweight or obese.

The researchers said very little research had been done on the influence of childcare on weight.

" **We know that obesity is a very complex issue with a wide range of factors involved** "
Department of Health spokesman

Yet childcare may have an effect on weight through diet and physical activity.

The study used data from the Millennium Cohort Study, which looked at the health of children aged between nine months and three years old, who had been born in the UK between 2000 and 2001.

The results showed that those looked after by grandparents part-time had a 15% higher risk of being overweight for their age compared with those solely looked after by their parents.

Those who were cared for by their grandparents full-time had a 34% increased risk of being overweight, the University College London team found.

Further analysis taking into account the child's socio-economic background, found the increased risk was only apparent in children from the most advantaged groups - whose mothers had a managerial or professional job, had a degree, or lived with their partner.

There was also an increased risk of being overweight associated with other informal care provided by relatives or friends but only if that was full-time.

'Best alternative'

The researchers said it was well-recognised that parents value care provided by grandparents and consider it to be the best alternative to full-time parent care.

They said the issue was about providing informal carers, such as grandparents, with better information and support around diet and exercise.

A recent announcement to provide grandparents with National Insurance credits for caring for grandchildren under the age of 13 years for at least 20 hours a week from 2011, "provides a potential opportunity for such health promotion", they advised.

Study leader Professor Catherine Law said this study, which was backed by other work done in the US, did not look at why grandparent care was associated with being overweight but that indulgence of children and lack of physical exercise were two possible explanations.

"One of the ways forward would be to talk to small groups of grandparents to see the challenges they face.

"Some of the things that might help would be educating the population in general about healthy lifestyles but also things like avoiding food as a reward and suggestions for building activities into daily life."

A Department of Health spokesman said: "We know that obesity is a very complex issue with a wide range of factors involved.

"The latest figures show that child obesity levels are the lowest reported since 2001. However, there's no doubt that levels of obesity in this country, as in the rest of the developed world, are far too high.

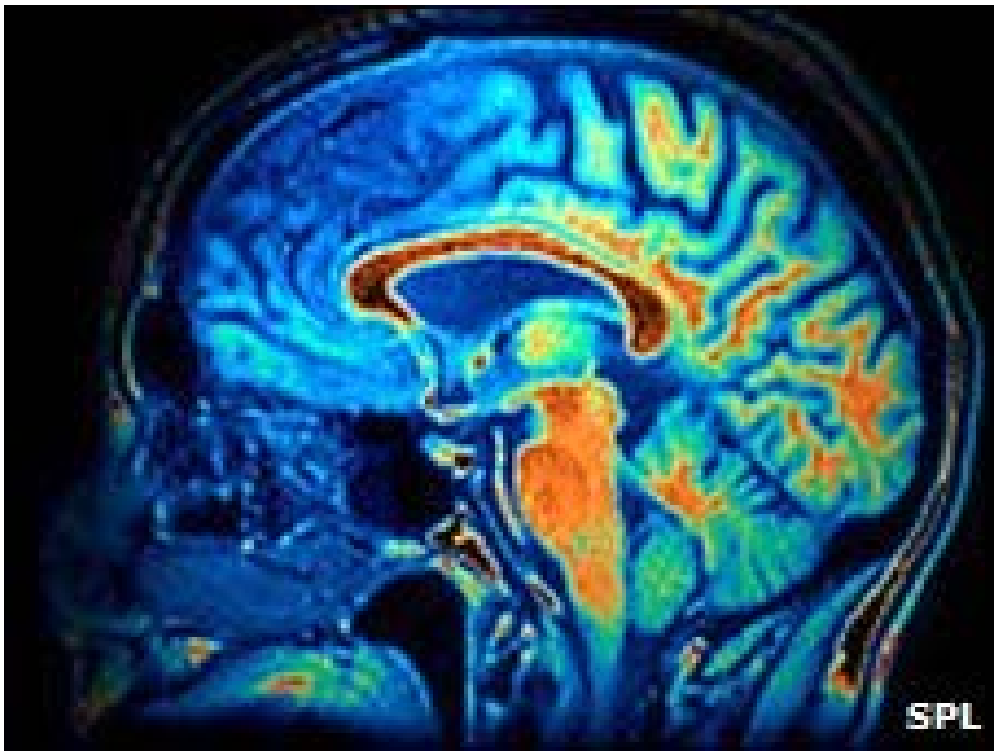
"That's why we're investing time, energy and money into preventing people from becoming obese in the first place."

Story from BBC NEWS:
http://news.bbc.co.uk/go/pr/fr/-/2/hi/health/8513112.stm

Published: 2010/02/15 01:17:43 GMT

Gene clue to early dementia speed

A gene that may give you an increased risk of a distressing early form of dementia has been identified by Cambridge scientists.



Fronto-temporal dementia (FTD) is the second most common type of dementia in the under 65s and can result in a complete personality change.

The researchers studied the brains of 515 people with FTD and found the gene on chromosome 7.

A charity said this could open the door to new treatments for the disease.

" **This significant new work adds to our understanding of the disease, and we hope it will boost research efforts** "
Rebecca Wood, Alzheimer's Research Trust

Writing in the journal Nature, Professor Maria Grazia Spillantini, of the University of Cambridge, said her team had established an international collaboration with investigators in 11 countries including the UK, the US, Belgium and Spain.

The Cambridge team compared the brains of 515 people with known FTD with 2,509 brains of people without the condition.

Several mutations

They found several different mutations on chromosome 7 which are thought to affect around half of the people with FTD.

These mutations increase the amounts of the protein the gene codes for.

About 20% of individuals with FTD have another kind of genetic mutation known as a GRN mutation.

Professor Spillantini thinks that the new gene accelerates the harm caused by the GRN mutation and makes the disease progress faster: "We found a specific gene that was associated with an increased risk of the disease.

"A better understanding of how the gene is involved could identify a new approach to tackle this disease."

Rebecca Wood, chief executive of the Alzheimer's Research Trust which part funded the study, said fronto-temporal dementia was an extremely distressing disease that affects thousands of families in the UK.

"This significant new work adds to our understanding of the disease, and we hope it will boost research efforts," she added.

Dr Susanne Sorenson, head of research at the Alzheimer's Society, said this was not the first gene found to be associated with FTD: "A gene causing fronto-temporal dementia in some families was identified for the first time last year.

"This is very exciting news as finding out what the proteins produced by these genes do could help us understand the processes that cause the condition."

Story from BBC NEWS:
http://news.bbc.co.uk/go/pr/fr/-/2/hi/health/8513110.stm

Published: 2010/02/15 00:18:36 GMT

Bee Healthy for Your Honey

By: Janice Arenofsky | February 13, 2010 | 11:00 AM (PDT) |

Explanations for honeybee colony collapse range from artificial sweeteners to loss of cropland, but solutions may be on offer.

High-fructose corn syrup is a hot topic in the national debate on diet, with opponents attacking it, as Daniel Engber has suggested, as unhealthy, unnatural and unappetizing, while corn refiners have volleyed back that it's safe, natural and tasty. Now the food additive has been implicated in the decline of another maker of sweeteners — honeybees.

Although researcher Blaise W. LeBlanc agrees that colony collapse disorder in honeybees probably results from a variety of environmental stresses such as mites, pesticides and infections (like *Nosema ceranae*), his recent, published experiments target a toxic byproduct of high-fructose corn syrup, which besides being an ingredient in processed human foods such as cereals, whole wheat bread and beverages, is also used as a nutritional supplement for bees.

LeBlanc, a former research chemist with the U.S. Department of Agriculture in Tucson and currently an instructor at nearby Pima Community College, identified the byproduct hydroxymethylfurfural, or HMF, as a potential culprit in colony collapse disorder.

He found that under four different temperatures (ranging from 89 degrees F to 156 degrees F), high-fructose corn syrup degraded enough in bees to cause ulceration and dysentery; above 120 degrees F, HMF levels doubled and bee deaths multiplied dramatically as observed in colony collapse. The syndrome is a serious threat — it destroyed 28.6 percent of total managed U.S. honeybee colonies, according to a survey from fall 2008 to spring 2009, and that followed more severe losses the two winters before.

Experts speculate that high-fructose corn syrup in the human food chain also may lead to disastrous consequences such as diabetes and obesity. "Swedish researchers found HMF in the urine [of people]," says LeBlanc. They also found DNA damage at higher HMF levels. German researchers, meanwhile, suggest HMF may act as a carcinogen in mice.

LeBlanc has a solution to minimize HMF toxicity: By adding bases (such as sodium bicarbonate, or baking soda, lime, potash or caustic soda) to HFCS, the pH (acid-alkaline balance) rises and, more importantly, HMF levels drop.

That more beekeepers do not apply this strategy is a negative LeBlanc blames on poor networking, weak communication, regional factors and the lack of academic regard for the non-peer-reviewed *American Bee Journal* as well as the shortage of funds for exploratory research (despite the USDA's appropriation of $20 million over the next five years). "A lot of issues could be cleared up at professional meetings," says LeBlanc, "if scientists completed surveys regarding environmental factors like native and invasive plants, temperature and diet."

Despite these impediments, the prevailing wisdom is to strengthen the honeybee's immune system by going "organic" as much as possible (there had been unsubstantiated reports organic colonies were not seeing colony collapse). Last month's federal court ruling revoking EPA approval of the toxic bee pesticide spirotetramat (sold as Movento and Ultor) — resulting from a suit brought by the Natural Resources Defense Council — may help to propel the industry in a healthier direction.

"The era of protein shakes for bees is here," writes Rowan Jacobsen, author of *Fruitless Fall: The Collapse Of The Honeybee And The Coming Agricultural Crisis*.

And why not boost this culinary "cocktail" with essential oils, ask scientists Margaret T. Chen, an adjunct member of the Vaccine Research Institute of San Diego, and Rance B. LeFebvre of the Veterinary School, University of California, Davis, who believe oils such as menthol, clove and cinnamon can ward off pests and strengthen bees' stomachs. LeBlanc recently confirmed the efficacy of carvacrol and thyme at controlling the Varroa mite and will study the combined effect on small hive beetles, another nuisance to bees.

All well and good, writes Dhruba Naug, assistant professor at Colorado State University in Fort Collins and author of a recent paper in *Biological Conservation*. But what if nutritional stress due to habitat loss is the "tipping point" for the deadly multi-stressor "synergistic effect" that culminates in colony collapse disorder? Naug's solution is straightforward: Preserve more open cropland and rangeland.

http://www.miller-mccune.com/science-environment/bee-healthy-for-your-honey-8678/?utm_source=Newsletter96&utm_medium=email&utm_content=0216&utm_campaign=newsletters

History and Health Cooperatives

By: Joan Melcher | February 12, 2010 | 05:00 AM (PDT) |

Depression-era health solution may find new favor in the modern American struggle for health care change.

When the U.S. Senate Finance Committee was wrangling to draft a health reform bill last summer, Sen. Kent Conrad (D-N.D.) suggested pushing aside the controversial public option in lieu of a system of health cooperatives. Many heads were raised: What was a health cooperative and could it address the myriad problems and complexities of patient care in the 21st century?

Despite a bevy of criticism and doubt from many Democrats leaning more to the left than most members of the Finance Committee, health cooperatives were included in the committee draft and survived the final cut of the Senate bill.

While the health care bill was all but confirmed dead after the election of Republican Scott Brown to fill a traditionally Democratic Senate seat from Massachusetts, recent stirrings of the near-cold cadaver have some health reform supporters hoping for one more chance. Speaker of the House Nancy Pelosi has suggested she might have the votes to use a budget reconciliation process to blend the House and Senate bills and pass comprehensive reform. It's likely that cooperatives would survive such a process, but to most people, they remain a vague but faintly hopeful concept, even as the director of research for the poster child of modern co-ops suggests that expecting co-ops to solve nationwide problems of access is "a tall order."

Although little known, they are not new on the American landscape. Several are operating today and health cooperatives provided care before health insurance became common; during the Great Depression 39 cooperatives served about 650,000 people.

A paper by a physician who has studied health care during that time offers both perspective and a bit of country wisdom.

"There's something about the transition in economic status that worsens people's health," said Michael Grey, chief of medicine at the Hospital of Central Connecticut and author of "Health Insurance Cooperatives: Lessons from the Great Depression," which appeared last month in the *Journal of the American Medical Association*.

He could have been talking about today — a Harvard University study found that in 2007 health costs were behind 62 percent of American bankruptcies — but Grey was referring to the health of rural Americans in the 1930s.

When the New Deal's Farm Service Administration found that half of all loan defaults by rural farmers were due to ill health, it came up with a solution: Bundle health care costs into farm loans and create health care cooperatives. At that time, the insurance concept was new to medicine, but the idea took hold.

Physicians participating in the program provided basic outpatient care and billed the cooperative for their services. Often a local judge was chosen as a trustee, and that person oversaw administration of the fund.

The participating doctors received about 65 percent of submitted bills, which at that time was much more than they would have received otherwise, Grey told Miller-McCune, and about what doctors receive today when billing Medicare for services.

In part due to the success of the cooperatives, 90 percent of all FSA loans were paid in full, Grey said.

The cooperatives waned in the late 1940s when leaders in the field thought the best medical care would come from supporting a national health insurance model. They pinned their hopes on President Harry Truman's health care proposal crafted in 1945.

The first president to propose a national approach to health care, Truman's plan tried to address a lack of doctors in rural areas and access to doctors and hospitals for lower-income communities.

The more controversial aspect of the bill was a proposed national health insurance plan run by the federal government that would be open to all Americans, but would remain optional. The proposal reached Congress in the form a of a Social Security expansion bill and was quickly attacked by the American Medical Association, which characterized the approach as "socialized medicine."

The bill went down in flames in 1947.

Flash forward six decades. Health cooperatives emerge in the summer of 2009 as an alternative to a nationally administered public health option. This time both the AMA and the American College of Physicians favor passage (although the AMA amended its position recently, saying it would withdraw support if Congress doesn't address Medicare rates paid to physicians).

The question is, can health cooperatives work?

Currently there are a handful of consumer health cooperatives in the country — in Washington state, Oregon, Wisconsin and Minnesota — serving an estimated 2 million members. Today's cooperatives act as the insurer, negotiating with providers to get the best services and rates for their members; many own their own hospitals and care centers.

Most have been in operation for decades, and all have been growing in recent years.

Grey believes they could work again on a national basis but only if allowed to operate like other consumer co-ops, such as credit unions, and if they achieve a large scale "so they can leverage cost savings and also have enough clout to push for best practices."

Currently, most co-ops are administrated through state law, and many states do not confer nonprofit, tax-exempt status on them. Such a designation allows the cooperative to plow profits back into capital improvements, lower premiums or expanded benefits, Grey said.

Size and the time needed for large entities to emerge are the other big issues. "It would take some time — and an effort on the part of Congress to level the playing field," Grey said, adding that national legislation should also allow cooperatives to extend across state borders.

The bill passed by the Senate Finance Committee allocates $6 billion for grants and loans to cover start-up costs and specifies that multiple awards not be made to states until all 50 states and the District of Columbia have had a chance to apply. However, it leaves it to the states to determine nonprofit status.

One cooperative that has been championed by those backing the cooperative model is Seattle's Group Health. Serving about 600,000 members in Washington state and northern Idaho, the cooperative dates to 1947; today its network of services includes 26 primary care centers, six specialty care units and one hospital.

In a paper Eric Larson, executive director of Group Health Research Institute, recently published in *The New England Journal of Medicine*, he describes innovations in patient care, success in conversion to electronic medical records and salaried doctors using a team approach to healing. But in that same paper "cost" reared its ugly head: In recent years Group Health's premiums have risen at nearly the same rate as for-profit insurers.

Larson said Group Health "aligns its price structure with those of competitors, because in the absence of insurance-market reform, not doing so would put it in an unsustainable, disadvantaged position of attracting sicker, higher-risk patients."

Grey acknowledged that large health cooperatives "have come to look more like the Aetnas" but said the only way to address the cost problem is for government to subsidize co-op members on a graduated scale.

A more fundamental problem, he said, is that to reduce costs and keep health care from reaching 20 percent of gross domestic product, "the only real solution is that we spend less for health care. You either provide less or pay less for what you're providing. Either way someone is getting less." (In the U.S. today, about 17 percent of GDP goes toward health care; for countries with universal coverage, 10 percent is the norm.)

Grey said expectations and Americans' penchant to always "want more" are at the root of some of the problems today. In the 1930s, "patients had more modest expectations of what they would get from their doctors.

"They wanted to go and they wanted to feel better, but there wasn't a presumption that they could be cured, or that there was a pill to take that would make it go away, or that there was a surgery or an imaging study. So the expectations for everybody now are so much higher than 70 years ago, and I think a lot of that is driven by real changes — advances in medicine — that are positive change. But that's come at a price literally and figuratively."

Grey said some sort of rationing of care will likely have to be accomplished in order to lower costs. "Isn't there some point where you have to balance the benefits for the few versus the cost for the many?" he asked."The real question is whether America is ready for that kind of conversation. It happens in all the other Western countries in the world. But in the United States we have such a difficult time tackling that in an honest way."

http://www.miller-mccune.com/business-economics/history-and-health-cooperatives-9007/

The Story of P(ee)

By: Melinda Burns | February 10, 2010 | 11:00 AM (PDT) |

In which phosphorus, a substance present in every living cell, is being used up and flushed away.

"P" is for phosphorus, the stuff of life, and "p" is for "peak phosphorus" by 2030, ecologists say, unless — presto! — pee can be turned into gold through modern-day alchemy.

Unremarked and unregulated by the United Nations and other high-level assemblies, the world's supply of phosphate rock, the dominant source of phosphorus for fertilizer, is being rapidly — and wastefully — drawn down. By most estimates, the best deposits will be gone in 50 to 100 years.

Worse, phosphorus production could peak in just two decades, according to new research from Australia and Sweden. That's when demand could outstrip supply, playing out a familiar scenario of scarcity, price shocks, riots, starvation and war.

In short, peak phosphorus could be the unwelcome sequel to peak oil.

"It's an emerging crisis," said Stuart White, director of the Institute for Sustainable Futures at the University of Technology in Sydney, Australia, and a co-author of two phosphorus studies published recently by *Global Environmental Change* and the International Conference on Nutrient Recovery from Wastewater Streams.

"Right now, you can get phosphorus if you're willing to pay for it," White said. "But global reserves will peak in 20 to 25 years. Africa has not stirred in terms of its phosphorus use. Africa could take off, and that's very scary.

"We will continue to mine phosphorus. It's just that if we want to extend the longevity of the resource, we'll have to reduce extraction rates significantly and put in much bigger recycling."

P in DNA
Peak phosphorus, as White and his colleagues describe it, based on data from the U.S. Geological Survey and the fertilizer industry, makes peak oil look like a cakewalk.

Both oil and phosphate rock are finite, non-renewable fossil resources that were created in deep geological time, whether from decaying biomass for oil or millennia of pooping seabirds for phosphate. But there are substitutes for oil; there is no substitute for phosphorus, an element that forms bones, sustains cell membranes and gives shape to the DNA and RNA in all living things.

"We are effectively addicted to phosphate rock," said Dana Cordell, a Ph.D. candidate who works with White and co-authored the recent studies. Cordell's thesis, *The Story of Phosphorus: Sustainable Implications of Global Phosphorus Scarcity for Food Security*, was published as an e-book by Linköping University in Sweden on Feb. 4.

"The quality of the remaining phosphate rock is declining," Cordell said. "We're going to have to shift away from our use of it. There is no single quick fix solution."

Worldwide, according to Cordell and White, five times more phosphorus is being mined than is being consumed. Stated another way, 15 million tons of phosphorus is mined yearly to grow food, but 80 percent never reaches the dinner table: It is lost to inefficiency and waste.

Farmers use too much fertilizer and it runs off the land, polluting streams, lakes and oceans. Industrial agriculture does not plow crop residues back into the soil after the harvest. In some countries, consumers throw away a third of their food, even when much of it is still edible.

Mature animals, including humans, excrete nearly 100 percent of the phosphorus they consume. But only half of animal manure — the largest organic and renewable source of phosphorus — is being recycled back onto farmland worldwide, studies show. And only 10 percent of what humans excrete is returned to agriculture as sludge or wastewater.

"We need to start talking about our pee and poo more seriously," Cordell said. "We need to be thinking in terms of 50 to 100 years."

In 2008, as the price of phosphorus skyrocketed from $50 to $400 per ton, Cordell, White and other scientists in Australia, Sweden, Canada and the Netherlands formed the Global Phosphorus Research Initiative. The group hopes to capture the attention of the U.N. by holding an international workshop Feb. 25 and 26 in Linköping.

"Phosphorus is an issue without a home," White said. "It falls in the cracks between nations."

The ABC's of P
Here's President Franklin D. Roosevelt, addressing the Congress in 1938:

I cannot over-emphasize the importance of phosphorus not only to agriculture and soil conservation but also to the physical health and economic security of the people of the nation.

Without phosphorus, the world cannot grow food. Yet only three countries control 73 percent of the world's remaining known reserves of phosphate rock. By contrast, the 13 members of the Organization of the Petroleum Exporting Countries control 75 percent of known oil reserves.

The U.S. now has only a 25-year supply left of phosphate rock, most of it is in Florida and North Carolina, studies show. China has the largest reserves — 27 percent of the total — but has clamped down

on exports with a steep tariff. Morocco is occupying the Western Sahara and its reserves and is exporting them to the U.S, even as the U.N. condemns the trade.

Africa is now both the largest exporter of phosphate rock and the continent with the worst food shortages.

"We're calling this the biggest problem no one's heard of," said James Elser, an Arizona State University ecologist who recently co-founded the Sustainable Phosphorus Initiative, a new research group on campus. (Arizona State will send representatives to the conference in Sweden this month, and next year, the university plans to host the second international summit on phosphorus.)

"The scope and urgency of the time scale need to be narrowed down," Elser said. "I don't think we have a really good consensus about the peak. Is this really an acute problem in 30 years? If this is true, then the human consequences are much more acute than anything we've seen with climate change, in terms of hunger. Food is food. We can't live without it."

By some estimates, peak phosphorus is already past. In a 2007 paper in *Energy Bulletin*, Canadian physicist Patrick Déry and co-author Bart Anderson hypothesized that global reserves of phosphate rock peaked in 1989.

"Phosphorus may be the real bottleneck of agriculture," they said, echoing a phrase from Isaac Asimov, a biochemist as well as science fiction writer, who called it "life's bottleneck."

White and Cordell dispute the 1989 date for peak phosphorus, saying that an apparent production decline in phosphorus after that year was only temporary: It was caused by the breakup of the Soviet Union and the saturation of fertilizer in European soils. In any case, they say, whenever the peak, the cost of production is indisputably going up and the quality of phosphate rock is declining.

"It's generally true that the data is very poor on the reserves," White said. "All it goes to show is that we can't really know definitely. But the principle remains."

P and the 3 R's

In *Dune*, his 1965 sci-fi classic, Frank Herbert imagines a futuristic empire at war over spice, a life-extending drug that is mined for interstellar travel. Spice is the most essential and most valuable commodity in the universe, and *Dune* chronicles the struggle for the desert planet Arrakis, the only place where spice is found.

Unfortunately, peak phosphorus is not science fiction.

Mark Edwards, a food marketing expert at Arizona State, believes that water and phosphorus are the two most critical problems for world food supply. Last year, in the course of writing a book on the crisis in world agriculture, titled, *Crash! The Demise of Fossil Food and the Rise of Abundance*, Edwards said he "did the math" and realized that phosphorus was running out.

Crash! contains a doomsday scenario for a "resource run" on phosphorus, complete with rumor, speculation, hoarding, guarded mines, restricted exports, high prices, bankrupt farmers and a hysterical press.

Edwards co-founded the Arizona State phosphorus initiative because, he said, "I wanted to verify that my math was correct. I was hoping it was wrong. I want to help farmers recover their waste nutrients.

"Phosphorus is way under the radar for everybody. Most scientists just aren't aware of it."

Phosphorus cannot be manufactured or synthesized in a lab. The only way to avert a supply crisis, researchers say, is to adopt the "3 R's" of sustainability: "Reduce, Reuse and Recycle."

For starters, they say, reducing demand means bucking a global trend and deliberately choosing to eat less meat. Meat- and dairy-based diets require up to three times as much phosphorus as vegetarian diets.

If the Western world switched *en masse* to a vegetarian diet, it could lower the world demand for phosphorus in fertilizers by as much as 45 percent, the studies show. If, on the other hand, Indians switched to a meat-based diet, it would triple India's demand for phosphorus.

"It goes to the heart of what people see as affluence," White said. "Can we afford to have 9 billion people in 2050 eating as high on the food chain as Americans and Australians do? The answer, clearly, is no. As Gandhi said, 'There's enough for everyone's need but not for everyone's greed.'

"It's not for me to tell other people what they should eat. But people in Western industrial countries have a choice. There is no need to eat meat."

Reuse and recycling are possible because, unlike oil, phosphorus can be recovered after it is used. For thousands of years, farmers did just that, plowing manure and human "night soil" back onto the land. In modern-day agriculture, however, animal feed lots are often thousands of miles away from the fields, and toilets flush away human waste.

Phosphorus cannot be destroyed, but it is becoming dissipated in the environment, Elser said. What's lost today to rivers and oceans will take another 10 to 15 million years to become phosphate rock on dry land, as happened on now depleted "phosphate islands" like the down-on-its-luck nation of Nauru.

"There's a whole industry that needs to be invented to capture phosphorus," Elser said. "We need a new way of growing crops that keeps it in the field instead of letting it run down into the Gulf of Mexico. We need plants that are more efficient at getting phosphorus.

"We're calling it 'closing the human-phosphorus cycle.'"Ideally, researchers say, cities will become phosphorus "hotspots" of urine and feces that can fertilize the surrounding farmland. Sweden for example, plans to recycle 60 percent of its phosphorus back into agriculture by 2015. Two Swedish cities presently require all new toilets to separate urine for use on local farms. The nutrients in one person's urine are believed to be sufficient to produce at least half and potentially all the food requirements for another person.

Using collected human waste as a source of otherwise hard to obtain chemicals like phosphorus dates back at least to Nero's "urine tax," while alchemists in Europe routinely decanted urine to refine elemental phosphorus for their experiments.Society's prevailing view of wastewater as a pollutant and not a resource has been called "urine blindness." Victor Hugo, the French novelist, saw it coming, various phosphorus studies have recalled. As he wrote in *Les Miserables* not long after the introduction of flush toilets in the mid 19th century:

Thanks to human dung, the earth in China is still as young as in the days of Abraham. Chinese wheat yields a hundredfold of the seed. There is no guano comparable in fertility with the detritus of a capital. A great city is the most mighty of dung-makers. Certain success would attend the experiment of employing the city to manure the plain. If our gold is manure, our manure, on the other hand, is gold.

http://www.miller-mccune.com/science-environment/the-story-of-pee-8736/?utm_source=Newsletter96&utm_medium=email&utm_content=0216&utm_campaign=newsletters

Children 'copy parents' drinking'

Parents underestimate the influence their own drinking habits have on their children's attitude to alcohol, government research suggests.

A Department for Children, Families and Schools study suggests children from heavy-drinking households are more likely to use alcohol themselves.

And half of young people who have drunk alcohol were given it by their parents.

It comes as ministers urge parents to help their children make sensible decisions about drinking alcohol.

The department commissioned research to get a clearer idea of the attitudes and use of alcohol among parents and young people.

The study was based on 4,000 interviews with parents, children and young people.

'Delay drinking'

It also found that eight out of 10 parents had no pre-planned strategies to tackle irresponsible drinking by their children.

One in four of the children interviewed said their parents had never talked to them about alcohol.

While the majority of parents said they were fully aware of their child's drinking habits, one in 10 said they were unaware if their child had drunk alcohol.

The research is being published as part of a campaign to tackle under-age drinking.

Schools Minister Vernon Coaker said: "Today's research shows that parents underestimate their influence over their child's drinking and attitudes to alcohol, yet a quarter of young people have never spoken to their parents about the issue.

"That's why through the Why Let Drink Decide? campaign we are giving parents and young people the confidence to have open conversations about alcohol, to ultimately delay the age at which young people start drinking."

Parental guidance

The chief medical officer for England advises that an alcohol-free childhood is the best option, but if children do drink alcohol they should not do so before the age of 15.

And then it should be with the guidance of a parent or carer.

Ministers are expected to provide new funds to help police enforce new powers to tackle the issue and to publish a best practice guide for local authorities as part of the campaign.

Positive alternatives to drinking alcohol, such as playing football, are also being encouraged as part of the campaign.

Story from BBC NEWS:
http://news.bbc.co.uk/go/pr/fr/-/2/hi/uk_news/education/8516745.stm

Published: 2010/02/16 00:00:26 GMT

Poor children 'lag a year behind'

Children from the poorest homes are almost a year behind middle class pupils by the time they start school, research suggests.

But good parenting, such as reading to children and having fixed bed times, can significantly reduce this gap, the study for the Sutton Trust says.

The educational charity urged the government to fund parenting classes, especially in deprived areas.

The government said the gap was closing fast but that there was more to do.

The Sutton Trust study looked at the results of a series of vocabulary tests carried out by 12,500 British children at the age of five.

It found those from the poorest homes were nearly a year behind in their results.

It also looked at the factors common to poorer children that might influence their development.

It found that just under half of those from the poorest fifth of families were born to younger mothers under 25.

" **We now have sound evidence about policies and programmes that raise achievement** "
Jane Waldfogel Report author

And just under two-thirds did not live with both biological parents, it said.

It also isolated some factors that boosted children's development on both the poorest and the richest homes.

These included "sensitive parental behaviour", such as ensuring regular bedtimes and reading daily to the child.

Regular bed times between the ages of three and five led to development gains of two-and-a-half months, researchers said.

Daily reading at the age of three boosted vocabulary development by nearly two months.

And children whose parents arranged monthly library visits were two-and-a-half months ahead of an equivalent child at the age of five who had not made similar trips.

According to the study, better parenting could reduce the achievement gap between middle-income and poor families by up to nine months.

However, just under half of children from the poorest homes were read to every day at the age of three, compared to 78% of children from the richest fifth of home.

More help

The authors noted that the UK had invested 4.3% of GDP on early years education in 2006.

But they called for a more effective early years strategy that would prevent greater numbers of children from disadvantaged backgrounds "falling behind their more fortunate peers before school has even begun".

Sutton Trust chairman Sir Peter Lampl said the findings were both shocking and encouraging - revealing the stark educational disadvantage experienced by children from poorer homes before they reached school.

But it also showed the potential for good parenting to overcome some of the negative impacts that poverty could have on children's early development, he said.

Study author Professor Jane Waldfogel, visiting professor at London School of Economics, said: "We now have sound evidence about policies and programmes that raise achievement for low-income children and help reduce gaps in early childhood.

"We also know that the best of these investments will yield returns well in excess of their costs."

'Focus on disadvantaged'

The report also called for more support for families from health professionals and early learning experts and special outreach projects to improve contact with vulnerable families.

Expansion of free nursery education should be focused on the 15% most disadvantaged families, it added.

Children's Minister Delyth Morgan said the government's rules on what is covered in childcare settings were ensuring that toddlers were learning through play and getting proper stimulation.

"The childcare entitlement means even low-income families can benefit from high quality childcare that prepares toddlers for school. "But let's be clear, whilst there is much more to do, the gap between rich and poor in early years is closing, with the lowest-achieving children not only keeping pace but improving faster than the rest.

"We will continue to focus extra resources on the most disadvantaged children," she added.

Chris Keates, general secretary of the Nasuwt teaching union, said: "An essential component of all early years' provision, public or private, is the employment of qualified teachers as part of the team around the child."

Story from BBC NEWS:
http://news.bbc.co.uk/go/pr/fr/-/2/hi/uk_news/education/8513340.stm

Published: 2010/02/15 02:24:36 GMT

Space rock contains organic feast

By Doreen Walton
Science reporter, BBC News

Scientists say that a meteorite that crashed into Earth 40 years ago contains millions of different carbon-containing, or organic, molecules.

Although they are not a sign of life, such organic compounds are life's building blocks, and are a sign of conditions in the early Solar System.

It is thought the Murchison meteorite could even be older than the Sun.

The results of the meteorite study are published in the Proceedings of the National Academy of Sciences.

"We are really excited. When I first studied it and saw the complexity I was so amazed," said Philippe Schmitt-Kopplin, lead researcher on the study from the Institute for Ecological Chemistry in Neuherberg, Germany.

"Having this information means you can tell what was happening during the birth of the Solar System," Dr Schmitt-Kopplin told BBC News.

" **We have to crush a few milligrams from the core of the meteorite** "
Dr Philippe Schmitt-Kopplin

"Meteorites are like some kind of fossil. When you try to understand them you are looking back in time," he explained.

The researchers says the identification of many different chemicals shows the primordial Solar System probably had a higher molecular diversity than Earth.

The Murchison meteorite landed in a town of that name in Australia in 1969. It has been examined before by scientists looking for specific compounds but this is the first non-targeted analysis and has confirmed a huge variety of carbon-based chemicals.

A study using high resolution analytical tools including spectroscopy allowed the team to identify 14,000 different compounds.

The scientists extrapolated the number on the basis of previous analyses done on natural organic matter.

The ultra-high-resolution mass spectrometry used shows only a fraction of the compounds that exist in the material being analysed, in this case the meteorite.

However the scientists say the prior studies allow them to make a good estimate of the total number of compounds. "We were very conservative in our calculations and interpolation," said Dr Schmitt-Kopplin.

"We have to crush a few milligrams from the core of the meteorite to enable the extractions with solvents and thus we only see the extractable fraction."

Burning question

Scientists believe the Murchison meteorite could have originated before the Sun was formed, 4.65 billion years ago. The researchers say it probably passed through primordial clouds in the early Solar System, picking up organic chemicals.

Dr Schmitt-Kopplin hopes the findings might contribute to the debate over how life on Earth originated.

"I guess many people working in these fields with access to this knowledge will have some further hypothesis and will possibly be having some of their hypotheses confirmed."

"Where did we come from and what happened before? We all have that question inside us."

The team is also analysing other meteorites but say Murchison is probably the most complex they have studied.

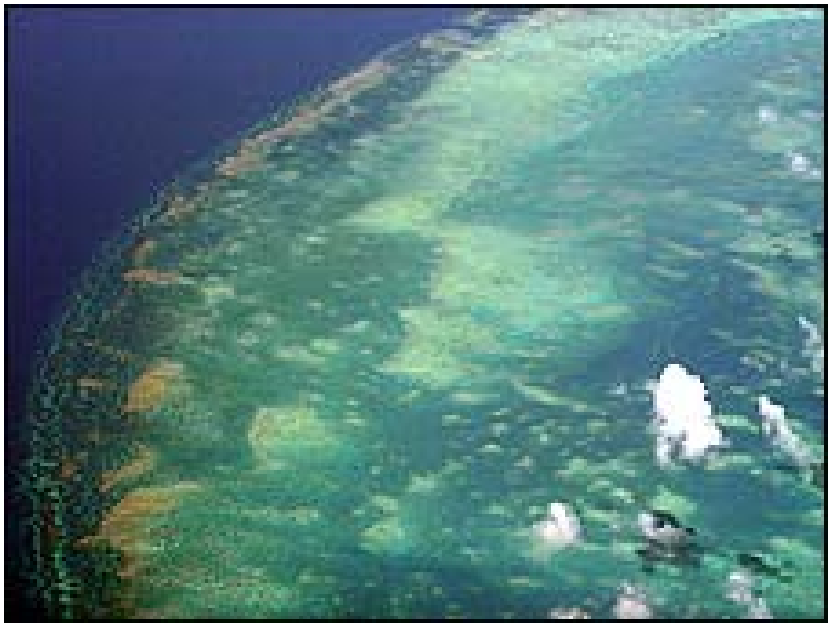
Story from BBC NEWS:
http://news.bbc.co.uk/go/pr/fr/-/2/hi/science/nature/8516319.stm

Published: 2010/02/16 13:24:24 GMT

Fossils 'record past sea changes'

By Mark Kinver
Science and environment reporter, BBC News

Fossilised coral reefs in the Great Barrier Reef could help scientists understand how sea levels have changed over the past 20,000 years.



An international team of researchers will spend 45 days at sea, gathering core samples from about 40 sites.

Described as the "trees of the sea", coral have growth rings that show seasonal variations.

Researchers say the samples will also shed light on past sea temperatures, as well as other changes to the reef.

Alan Stevenson, team leader of marine geology at the British Geological Survey (BGS), which is involved in the project, said the fossilised corals' annual growth rings provided an insight to conditions under waves.

"We can then analyse those rings to build up a very detailed picture of what the ocean was like when they were forming, including temperature and salinity.

'Time capsule'

Mr Stevenson told BBC News that the Great Barrier Reef - the world's largest coral reef system - was about half a million years old.

"Over this time, parts have died out... as sea levels change. Basically, corals drown when it becomes too deep for them."

The team will collect core samples of fossilised coral that developed between 20,000 to 10,000 years ago.

"We will core into a 'time capsule' of sediments that holds information on the environmental evolution of the reef since the last glaciation some 20,000 years ago," said Dan Evans, a marine geologist at BGS and science manager for the Ecord Science Operator.

Researchers currently believe that there were three periods in which there was accelerated sea level rise: 19,000, 13,800 and 11,300 years ago.

"By understanding more about the past, we can understand a little bit more about the future," said Mr Stevenson.

The team, on board the survey vessel Greatship Maya , will gather core samples, some of which will reach down to 150m (490ft) below the seabed.

The expedition would not be disturbing live coral in the world heritage site, Mr Stevenson stressed.

"Obviously, it is a national park and we are in there with the permission of the Great Barrier Reef Marine Park authority. If they were not happy, then we would not be there."

The expedition is being funded by the European Consortium for Ocean Research Drilling (Ecord) and forms part of the Integrated Ocean Drilling Program (IODP).

Story from BBC NEWS:
http://news.bbc.co.uk/go/pr/fr/-/2/hi/science/nature/8512985.stm

Published: 2010/02/15 09:25:59 GMT

Simple test can spot concussion

Spotting athletes who are still unfit to return to action days or weeks after a blow to the head could be made simpler by a new test.

The check, devised by University of Michigan scientists, looks for sluggish reaction times.

Those too slow to catch a falling object - a weighted cylinder - are likely to have concussion.

A UK expert warned athletes should expect a three-week layoff after concussion.

Minor head injuries are part and parcel of many of the most popular sports in the UK, particularly contact sports such as rugby.

" **If these symptoms are recognised in a player, it is vital they are removed from the field of play and taken to the nearest accident and emergency ward for proper medical assessment** "
Luke Griggs, Headway

Many of these concussions go undetected by the player or their coaches.

And even when spotted, there is some uncertainty as to when the player should be allowed to compete again.

The after-effects can linger for several days, even after other more obvious symptoms such as headaches, dizziness and confusion have abated.

Simple check

The Michigan test involved 209 young male and female footballers and wrestlers.

They were asked to catch the weighted cylinder when it was dropped by the coach, and their speed of response was recorded.

Then, during the season, if any of them suffered a concussion, the test was repeated a few days afterwards.

Seven of the athletes had a longer reaction time - on average 15% longer.

Dr James Eckner, who devised the test, said: "Because of its simplicity and low cost, this test may work well with youth athletes, where there is limited access to computerised testing of reaction time."

He will showcase his work at the American Academy of Neurology's 62nd annual meeting in Toronto in April.

Play safe

Luke Griggs, from the head injury charity Headway, said that while the findings were interesting, more research would have to be carried out to confirm them.

He added that anyone displaying the signs of concussion should be taken to hospital.

He said: "There are a number of symptoms to look out for when attempting to spot concussion, including blurred vision, disorientation and the inability to concentrate.

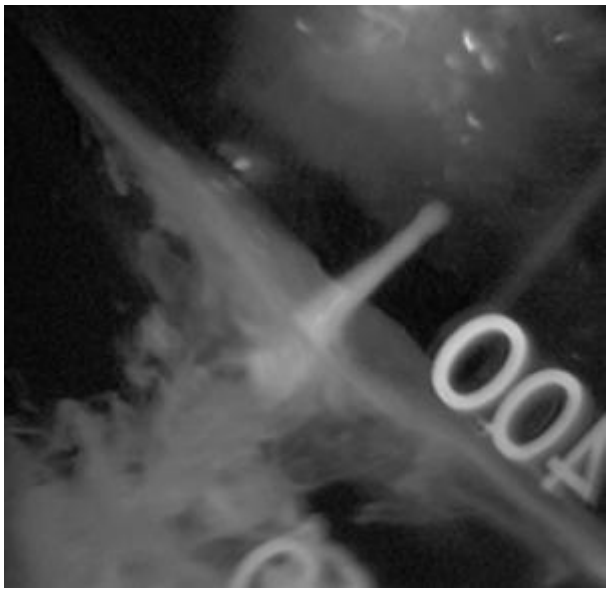
"If these symptoms are recognised in a player, it is vital they are removed from the field of play and taken to the nearest accident and emergency ward for proper medical assessment.

"They should then refrain from playing any contact sport for at least three weeks unless told otherwise by a doctor."

Story from BBC NEWS:
http://news.bbc.co.uk/go/pr/fr/-/2/hi/health/8516949.stm

Published: 2010/02/16 02:25:12 GMT

Cameras of the Future: Heart Researchers Create Revolutionary Photographic Technique



The image shows a drop of milk falling into a beaker of water. A video was made at the same time, using the same camera, and represents the same image data. The still image has a 16 fold greater spatial resolution (see swirls of milk in the beaker), and it can be decoded into the video frames played in sequence to reveal the high-speed motion content. (Credit: Copyright Dr Gil Bub, University of Oxford)

ScienceDaily (Feb. 15, 2010) — Scientists at the University of Oxford have developed a revolutionary way of capturing a high-resolution still image alongside very high-speed video -- a new technology that is attractive for science, industry and consumer sectors alike.

By combining off-the-shelf technologies found in standard cameras and digital movie projectors they have successfully created a tool that will transform many forms of detailed scientific imaging and could provide access to high-speed video with high-resolution still images from the same camera at a price suitable for the consumer market. This could have everyday applications for everything from CCTV to sports photography and is already attracting interest from the scientific imaging sector where the ability to capture very high quality still images that correspond exactly to very high speed video is extremely desirable and currently very expensive to achieve. The technology has been patented by Isis Innovation, the University of Oxford's technology transfer office, which provided seed funding for this development and welcomes contact from industry partners to take the technology to market. The research is published February 14, 2010 in *Nature Methods*.

Dr Peter Kohl and his team study the human heart using sophisticated imaging and computer technologies. They have previously created an animated model of the heart, which allows one to view the heart from all angles and look at all layers of the organ, from the largest structures right down to the cellular level. They do this by combining many different types of information about heart structure and function using powerful computers and advanced optical imaging tools. This requires a combination of speed and detail, which has been difficult to achieve using current photographic techniques.

Dr Kohl said: "Anyone who has ever tried to take photographs or video of a high-speed scene, like football or motor racing, even with a fairly decent digital SLR, will know that it's very difficult to get a sharp image because the movement causes blurring. We have the same problem in science, where we may miss really vital information like very rapid changes in intensity of light from fluorescent molecules that tell us about what is happening inside a cell. Having a massive 10 or 12 megapixel sensor, as many cameras now do, does absolutely nothing to improve this situation.

"Dr Gil Bub from my team then came up with a really great idea to bring together high-resolution still images and high-speed video footage, at the same time and on the same camera chip -- 'the real motion picture'! The sort of cameras researchers would normally need to get similar high-speed footage can set you back tens of thousands of pounds, but Dr Bub's invention does so at a fraction of this cost. This will be a great tool for us and the rest of the research community and could also be used in a number of other ways that are useful to industry and consumers."

"What's new about this is that the picture and video are captured at the same time on the same sensor" said Dr Bub. "This is done by allowing the camera's pixels to act as if they were part of tens, or even hundreds of individual cameras taking pictures in rapid succession during a single normal exposure. The trick is that the pattern of pixel exposures keeps the high resolution content of the overall image, which can then be used as-is, to form a regular high-res picture, or be decoded into a high-speed movie."

The technique works by dividing all the camera's pixels into groups that are then allowed to take their part of the bigger picture in well-controlled succession, very quickly, and during the time required to take a single 'normal' snapshot. So for example, if you use 16 pixel patterns and sequentially expose each of them for one sixteenth of the time the main camera shutter remains open, there would be 16 time points at which evenly distributed parts of the image will be captured by the different pixel groups. You then have two choices: either you view all 16 groups together as your usual high-resolution still image, or you play the sixteen sub-images one after the other, to generate a high-speed movie.

This concept has attracted the attention of Cairn Research, a UK based scientific instrument manufacturer. "High speed imaging of biologically important processes is critical for many of our customers at Cairn Research," said Dr Martyn Reynolds, "Frequently there is a requirement to record events in living cells that are over in a fraction of a second, and this pushes us to the limits of existing technology. For several years we have been developing a product line for fast imaging of optical slices though cells, and we are very interested in using the processes and technology developed by the group in Oxford to extend the capabilities of our devices and the scientific benefits this could bring."

The research may soon move from the optical bench to a consumer-friendly package. Dr. Mark Pitter from the University of Nottingham is planning to compress the technology into an all-in-one sensor that could be put inside normal cameras. Dr Pitter said: "The use of a custom-built solid state sensor will allow us to design compact and simple cameras, microscopes and other optical devices that further reduce the cost and effort needed for this exciting technique. This will make it useful for a far wider range of applications, such as consumer cameras, security systems, or manufacturing control."

This research was funded by the Biotechnology and Biological Sciences Research Council and the British Heart Foundation.

Story Source:

Adapted from materials provided by Biotechnology and Biological Sciences Research Council.

Journal Reference:

1. Gil Bub, Matthias Tecza, Michiel Helmes, Peter Lee & Peter Kohl. **Temporal pixel multiplexing for simultaneous high-speed, high-resolution imaging**. *Nature Methods*, 14 February 2010 DOI: 10.1038/nmeth.1429

http://www.sciencedaily.com/releases/2010/02/100214143129.htm

Virtual Museum Guide

Visitors can browse and select the information that interests them most. (Credit: Copyright Fraunhofer IGD)

ScienceDaily (Feb. 15, 2010) — Archaeological treasures are brought to life by Fraunhofer software. Real images are enriched with digital information on a virtual tour through ancient buildings, creating a more vivid experience for the museum visitor.

Every visitor would like to embark on a virtual time journey into the past. Researchers have already set the stage for just such a journey, as exemplified by a recent exhibition in the Allard Pierson Museum in Amsterdam, where visitors could take a stroll through historical sites. A flat screen on a rotating column stood beside the many art works, showing an extract of the image on the wall -- a gigantic black and white photo of the Roman Forum ruins. When the column is rotated to the left, this correspondingly changes what the viewer sees. A camera connected to the back of the movable display provides information about the new view appearing on the monitor -- in this case, the Temple of Saturn ruins. At the same time, a digital animation shows what the temple might have looked like when intact. If the screen is rotated further, it displays information, pictures and videos about other ancient buildings, including the Colosseum.

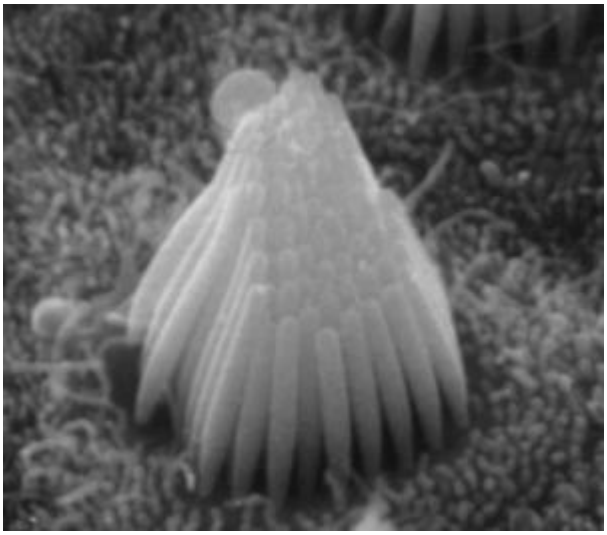
The sophisticated animation is based on software developed by the Fraunhofer Institute for Computer Graphics Research IGD in Darmstadt. "We have taught the computer to recognize the image," explains Fraunhofer IGD researcher, Michael Zöllner. "The program knows where the center of the camera is pointing and can superimpose the relevant overlay -- a text, video or animation." The original image can always be clearly seen under the overlays, so that visitors always know where they are on the virtual tour. This technology is known as augmented reality to the experts.

The Fraunhofer IGD software in the museum currently runs on a mini-computer, controlled via a touch screen. This handy console clearly indicates a trend towards mobile, virtual guidebooks. When tourists will hold their consoles in front of a baroque prince's palace, the relevant customized information will appear immediately on their screens. Fraunhofer IGD researchers have tested this vision in practice in the iTACITUS project, in which Zöllner's team programmed a portable computer to act as an electronic tourist guide for the Royal Palace of Venaria near Turin. New mobile phone technology could accelerate acceptance of augmented reality. "The smart phone means that augmented reality is at last suitable for the mass market," Zöllner says.

Story Source:

Adapted from materials provided by Fraunhofer-Gesellschaft.
http://www.sciencedaily.com/releases/2010/02/100210164838.htm

Built-in Amps: How Subtle Head Motions, Quiet Sounds Are Reported to the Brain



A single hair cell from a frog ear magnified by a scanning electron microscope. Hair cells are essential sound and balance detectors in the inner ear. The study of these cells, which are a limited commodity and easily damaged in humans, is key to understanding hearing and balance loss. (Credit: Image by Jason Meyers, Assistant Professor of Biology, Colgate University)

ScienceDaily (Feb. 15, 2010) — The phrase "perk up your ears" made more sense last year after scientists discovered how the quietest sounds are amplified in the cochlea before being transmitted to the brain.

When a sound is barely audible, extremely sensitive inner-ear "hair cells" -- which are neurons equipped with tiny, sensory hairs on their surface -- pump up the sound by their very motion and mechanically amplify it. Richard Rabbitt of the University of Utah, a faculty member in the MBL's Biology of the Inner Ear course, reported last spring on the magnification powers of the hair cell's hairs.

Now, Rabbitt and MBL senior scientist Stephen Highstein have evidence that hair cells perform similarly in another context -- in the vestibular system, which sends information about balance and spatial orientation to the brain.

"The bottom line is we have 'accelerometers' in the head that report on the direction of gravity and the motion of the head to the brain," says Highstein. "What we found is they respond with a greater magnitude than expected for very small motions of the head. This brought to mind a similar amplification of very small signals by the human inner-ear cochlea. And, in fact, the vestibular system and the cochlea have a sensory element in common: the hair cells." Rabbitt and Highstein found that, in both the auditory and the vestibular systems, the hair cell response exhibits "compressional nonlinearity": The lower the strength of the stimulus, the more the hair cells "tune themselves up to amplify the stimulus," Highstein says.The toadfish was used for this study. "What's interesting is the boney fishes evolved some 3 to 4 million years ago; subsequently this feature of its hair cells was apparently co-opted by the mammalian cochlea. Evolution conserved this feature, and the mammal later used it to improve hearing sensitivity," Highstein says.

Story Source:

Adapted from materials provided by Marine Biological Laboratory.

Journal Reference:

1. Rabbitt et al. **Mechanical amplification by hair cells in the semicircular canals**. *Proceedings of the National Academy of Sciences*, 2010; DOI: 10.1073/pnas.0906765107

http://www.sciencedaily.com/releases/2010/02/100209091842.htm

Hypothesis on the Mystery of Dengue Virus Infection Confirmed

ScienceDaily (Feb. 15, 2010) — A leading immunology research institute has validated the long-held and controversial hypothesis that antibodies -- usually the "good guys" in the body's fight against viruses -- instead contribute to severe dengue virus-induced disease, the La Jolla Institute for Allergy & Immunology has announced. The finding has major implications for the development of a first-ever vaccine against dengue virus, a growing public health threat which annually infects 50 to 100 million people worldwide, causing a half million cases of the severest form.

"Our lab has proven the decades old hypothesis that subneutralizing levels of dengue virus antibodies exacerbate the disease," said La Jolla Institute scientist Sujan Shresta, Ph.D, noting this occurs in people with secondary dengue virus infections who have antibodies to the virus due to a previous infection. "This is a situation where antibodies can be bad for you, which is counter to everything we know about the normal function of antibodies. It also presents a special challenge for researchers working to develop a dengue virus vaccine, since most vaccines work by prompting the body to produce antibodies."

Dengue infection is transmitted by mosquitoes and is caused by any of four closely related virus serotypes of the genus Flavivirus. Infection can cause diseases ranging from dengue fever, a flu-like illness, to the severest form -- dengue hemorrhagic fever/dengue shock syndrome (DHF/DSS), which can cause the blood vessels to leak, leading to life-threatening shock. Dengue infection hits hardest in tropical and subtropical areas of Southeast Asia and Latin America.

The dengue virus antibody phenomenon, termed antibody-dependent enhancement of infection (ADE), was first hypothesized in the 1970s by Scott Halstead, M.D., one of the world's top experts on dengue virus infection. Dr. Halstead said he got his first inkling of the phenomenon while doing extensive clinical studies of dengue virus patients in Thailand in the 1960s. "We were able to detect that the severe patients all had a secondary antibody response, meaning that they had all been infected before," he said. "That was the first evidence we had that a person had to have a previous dengue infection to get the severe disease." Further epidemiological observations, including cases in which severe dengue virus occurred in infants born to previously infected mothers, along with lab cell studies, prompted Dr. Halstead to put forth the ADE hypothesis. Dr. Shresta's work, conducted in mouse models, provides the first in vivo proof of ADE's occurrence.

Dr. Halstead said he is pleased to see his hypothesis proven in animal studies, but actually finds Dr. Shresta's development of a solid dengue virus mouse model even more exciting. Dr. Shresta is credited with developing the world's first mouse model showing key aspects of human infection.

"A model like this is really a breakthrough in tools," said Dr. Halstead, who is research director for the Pediatric Dengue Vaccine Initiative at the International Vaccine Institute, Seoul, Korea and a consultant to the Rockefeller Foundation in New York. "We've been looking for 40 years for a model to be able to test this (ADE) phenomenon. It will allow us to study the virus and the antibody enhancement in ways never before possible."

Using the mouse model, the Shresta group has already made a key and surprising observation that a type of liver cells, called liver sinusoidal endothelial cells (LSCEs), but not the previously expected cells types (such as macrophages and dendritic cells) support ADE of dengue infection.

Scientists had long complained that the lack of a good animal model hampered efforts to develop a first-ever dengue vaccine. Dr. Shresta said her group's ADE findings emphasize the importance of special caution in designing a dengue virus vaccine. "Researchers will have to be extremely careful to ensure that, under no conditions, will a dengue vaccine generate these subneutralizing antibody conditions," she said. "Otherwise, it could cause people to develop the severest and potentially lethal form of the disease -- dengue hemorrhagic fever/dengue shock syndrome."

Dr. Halstead agreed and said efforts should focus on a vaccine that protects against all four serotypes to avoid subsequent infections. "The vaccine should cause you to make antibodies to each of the four dengue viruses," he said, noting that he is working with several groups using this approach. "That's what makes it difficult; you have to make four vaccines in one. The kind of model Dr. Shresta has done will be important as researchers work to develop a vaccine."

Dr. Shresta's findings were published online February 11 in Cell Host & Microbe in her paper entitled, "Enhanced Infection of Liver Sinusoidal Endothelial Cells in a Mouse Model of Antibody-Induced Severe Dengue Disease."

Dr. Shresta said the fact that dengue viruses exist as four different serotypes that circulate simultaneously underlies the development of the subneutralizing antibodies. Infection with one of these serotypes provides lifelong immunity to the infecting serotype only. In subsequent dengue infections, where a different serotype of the virus is involved, the antibodies do not recognize enough of the virus to neutralize it. "This starts a cascade of unusual molecular events -- the ADE process -- which leads to the antibodies contributing to, rather than fighting, the dengue infection," she said.

The World Health Organization (WHO) estimates that about 2.5 billion people, or 40% of the world's population, live in areas where there is a risk of dengue transmission. About 500,000 cases of dengue's severest form (DHF/DSS) occur annually, resulting in about 24,000 deaths, mostly among children. Tropical and subtropical areas of Southeast Asia and Latin America are hardest hit by dengue infection. Although dengue rarely occurs in the continental United States, it is endemic in Puerto Rico, a U.S. territory. Mosquitoes capable of transmitting the virus have been found in the U.S. over the last 10 years.

Story Source:

Adapted from materials provided by La Jolla Institute for Allergy and Immunology.

Journal Reference:

1. Raphaël M. Zellweger, Tyler R. Prestwood, Sujan Shresta. **Enhanced Infection of Liver Sinusoidal Endothelial Cells in a Mouse Model of Antibody-Induced Severe Dengue Disease**. *Cell Host & Microbe*, February 11, 2010 DOI: 10.1016/j.chom.2010.01.004

http://www.sciencedaily.com/releases/2010/02/100211121756.htm

Urbanization, Export Crops Drive Deforestation

Clearing for large-scale agriculture in Mato Grosso, Brazil. (Credit: Doug Morton/Goddard Space Flight Center)

ScienceDaily (Feb. 15, 2010) — The drivers of tropical deforestation have shifted in the early 21st century to hinge on growth of cities and the globalized agricultural trade, a new large-scale study concludes. The observations starkly reverse assumptions by some scientists that fast-growing urbanization and the efficiencies of global trade might eventually slow or reverse tropical deforestation. The study, which covers most of the world's tropical land area, appears in this week's early edition of the journal *Nature Geoscience.*

Deforestation has been a rising concern in recent decades, especially with the recognition that it may exacerbate climate change. Studies in the late 20th century generally matched it with growing rural populations, as new roads were built into forests and land was cleared for subsistence agriculture. Since then, rural dwellers have been flooding into cities, seeking better living standards; 2009 was recorded as the first year in history when half of human lived in urban areas. Large industrial farms have, in turn, taken over rural areas and expanded further into remaining forests, in order to supply both domestic urban populations and growing international agricultural markets, the study suggests.

"The main drivers of tropical deforestation have shifted from small-scale landholders to domestic and international markets that are distant from the forests," said lead author Ruth DeFries, a professor at the Earth Institute's Center for Environmental Research and Conservation. "One line of thinking was that concentrating people in cities would leave a lot more room for nature. But those people in cities and the rest of the world need to be fed. That creates a demand for industrial-scale clearing."

DeFries and her colleagues analyzed remote-sensing images of forest cover across 41 nations in Latin America, Africa and Asia from 2000-2005, and combined these with population and economic trends.

They showed that the highest forest losses were correlated with two factors: urban growth within countries; and, mainly in Asia, growth of agricultural exports to other countries. Rural population growth was not related.

In recent years, tropical countries have been supplying growing amounts of palm oil, soybeans, sugar, meat and other processed products to distant markets abroad. Not all the products are used for food; palm oil and sugar in particular are also being converted into biofuels. Furthermore, said DeFries, as small farmers within tropical nations move away to become city dwellers, they may actually use more resources from the countryside, not less. This is because those living in cities have higher incomes -- the reason most moved there to begin with -- and thus tend to consume more processed foods and animal products. Pastures needed to produce meat, and large plantations and other facilities that turn out other products, in turn, require land. "Collectively, these results indicate a shift from state-run road building and colonization in the 1970s and 1980s to enterprise-driven deforestation," says the study.

Hot spots of industrial-scale clearing include Brazil, Indonesia and Cambodia -- countries that, unlike many others, still have considerable forests left to clear. The trend has not reached some forested parts of Latin America, such as Surinam or Guyana, which also have large tracts of remaining forest. Almost 60% of remaining forests occur in areas where net agricultural trade, percent of products exported, and urban growth are all relatively low. But as demand for products grows, these areas are likely to see increased pressure, the study says. According to projections by the United Nations, nearly all population growth in the next 40 years will take place in cities, and some two-thirds of people will live there by 2050.

DeFries said that some initiatives aimed at halting deforestation need to be quickly shifted. For instance, some policies that focus on getting small landowners to conserve forests -- a popular mechanism among governments and nonprofits at the moment -- "may not be all that productive without a focus on large-scale clearing as well," she said. "Governments will have to look at policies that intensify yields on existing high-yield fields -- not clear more land," she said.

The other authors of the study are Columbia University ecologist Maria Uriarte; ecologist Thomas Rudel of Rutgers University; and Matthew Hansen of South Dakota State University.

Story Source:

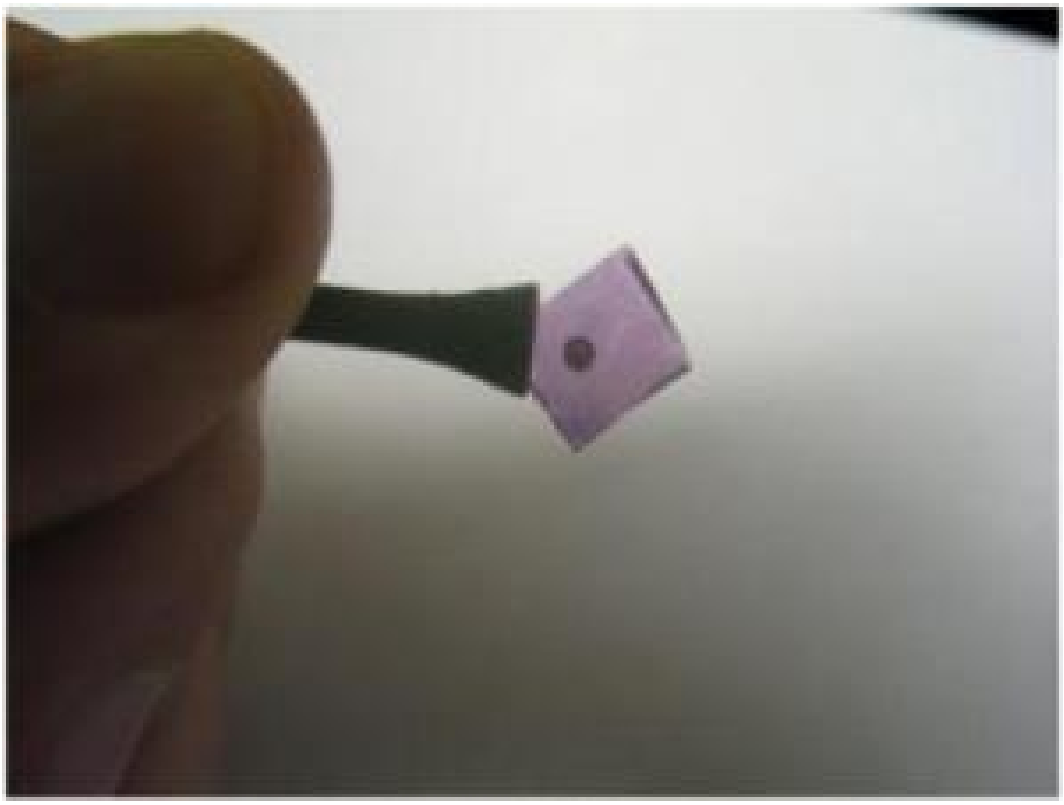
Adapted from materials provided by The Earth Institute at Columbia University.

Journal Reference:

1. DeFries et al. **Deforestation driven by urban population growth and agricultural trade in the twenty-first century**. *Nature Geoscience*, 2010; DOI: 10.1038/ngeo756

http://www.sciencedaily.com/releases/2010/02/100209183246.htm

Scientists Turn Light Into Electrical Current Using a Golden Nanoscale System



Material scientists at the Nano/Bio Interface Center of the University of Pennsylvania have demonstrated the transduction of optical radiation to electrical current in a molecular circuit. (Credit: Dawn Bonnell, the University of Pennsylvania)

ScienceDaily (Feb. 14, 2010) — Material scientists at the Nano/Bio Interface Center of the University of Pennsylvania have demonstrated the transduction of optical radiation to electrical current in a molecular circuit. The system, an array of nano-sized molecules of gold, respond to electromagnetic waves by creating surface plasmons that induce and project electrical current across molecules, similar to that of photovoltaic solar cells.

The results may provide a technological approach for higher efficiency energy harvesting with a nano-sized circuit that can power itself, potentially through sunlight. Recently, surface plasmons have been engineered into a variety of light-activated devices such as biosensors.

It is also possible that the system could be used for computer data storage. While the traditional computer processor represents data in binary form, either on or off, a computer that used such photovoltaic circuits could store data corresponding to wavelengths of light.

Because molecular compounds exhibit a wide range of optical and electrical properties, the strategies for fabrication, testing and analysis elucidated in this study can form the basis of a new set of devices in which plasmon-controlled electrical properties of single molecules could be designed with wide implications to plasmonic circuits and optoelectronic and energy-harvesting devices.

Dawn Bonnell, a professor of materials science and the director of the Nano/Bio Interface Center at Penn, and colleagues fabricated an array of light sensitive, gold nanoparticles, linking them on a glass substrate. Minimizing the space between the nanoparticles to an optimal distance, researchers used optical radiation to excite conductive electrons, called plasmons, to ride the surface of the gold nanoparticles and focus

light to the junction where the molecules are connected. The plasmon effect increases the efficiency of current production in the molecule by a factor of 400 to 2000 percent, which can then be transported through the network to the outside world.

In the case where the optical radiation excites a surface plasmon and the nanoparticles are optimally coupled, a large electromagnetic field is established between the particles and captured by gold nanoparticles. The particles then couple to one another, forming a percolative path across opposing electrodes. The size, shape and separation can be tailored to engineer the region of focused light. When the size, shape and separation of the particles are optimized to produce a "resonant" optical antennae, enhancement factors of thousands might result.

Furthermore, the team demonstrated that the magnitude of the photoconductivity of the plasmon-coupled nanoparticles can be tuned independently of the optical characteristics of the molecule, a result that has significant implications for future nanoscale optoelectronic devices.

"If the efficiency of the system could be scaled up without any additional, unforeseen limitations, we could conceivably manufacture a one-amp, one-volt sample the diameter of a human hair and an inch long," Bonnell said.

The study, published in the current issue of the journal ACS Nano, was conducted by Bonnell, David Conklin and Sanjini Nanayakkara of the Department of Materials Science and Engineering in the School of Engineering and Applied Science at Penn; Tae-Hong Park of the Department of Chemistry in the School of Arts and Sceicnes at Penn; Parag Banerjee of the Department of Materials Science and Engineering at the University of Maryland; and Michael J. Therien of the Department of Chemistry at Duke University.

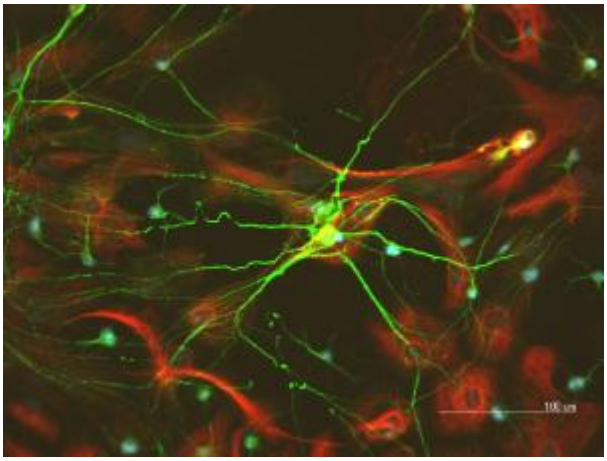
This work was supported by the Nano/Bio Interface Center, National Science Foundation, the John and Maureen Hendricks Energy Fellowship and the U.S. Department of Energy.

Story Source:

Adapted from materials provided by University of Pennsylvania, via EurekAlert!, a service of AAAS.

http://www.sciencedaily.com/releases/2010/02/100212172537.htm

Catching Calcium Waves Could Provide Alzheimer's Insights



Neurons (green) and astrocytes (red) grown in culture. Astrocytes have become a hot research topic as evidence mounts suggesting that astrocytes in the brain's cortex do more than provide support to neurons. (Credit: Chris MacDonald / UC San Diego)

ScienceDaily (Feb. 14, 2010) — New insights on what causes Alzheimer's disease could arise from a recent discovery made by bioengineers from the University of California, San Diego. The finding concerns the infamous amyloid beta peptides (Aβ) -- fragments of which form plaques thought to play a role in Alzheimer's disease.

The bioengineers found that amyloid beta peptides (Aβ) spontaneously trigger calcium waves in purified cultures of astrocyte cells extracted from the cortex region of rat brains and grown in the lab. These calcium waves could be relevant for understanding the origin of Alzheimer's disease. The accumulation of Amyloid beta fragments and sustained disruption of the calcium balance within cells are leading hypotheses for what causes Alzheimer's disease.

The work also adds to researchers' understanding of a class of cells found in the brain called astrocytes, which have become a hot research topic as evidence mounts suggesting that astrocytes in the brain's cortex do more than provide support to neurons.

The UC San Diego bioengineers published the new findings in the January 25, 2010 issue of the journal *ASN NEURO*. "We didn't generate these waves artificially. Amyloid beta fragments induced the waves spontaneously, and that raises some interesting questions about the pathophysiology of Alzheimer's disease and how astrocytes may be involved," said bioengineering professor Gabriel Silva from the UC San Diego Jacobs School of Engineering and the senior author on the paper.

The calcium waves Silva and his team observed have not been reported in astrocyte networks in healthy brain cortex tissue, but they have been seen in the cortexes of rats with Alzheimer's disease. "The fact that amyloid beta peptides -- independent of any other cell type -- are able to induce calcium waves in astrocyte networks is one of the major findings of the paper," said Silva, who is also affiliated with UC San Diego's Department of Ophthalmology, Neurosciences Program, and Institute of Engineering in Medicine. The new UC San Diego finding that amyloid beta peptides spontaneously trigger the formation of calcium waves in networks of purified astrocytes from the rat brain cortex could prove useful for determining the role that astrocytes play in Alzheimer's disease. This, in turn, could help to clarify what causes Alzheimer's disease and could suggest new drug targets to either slow down or reverse the widespread neuronal death associated with Alzheimer's disease, the bioengineers conclude. There is currently no cure for Alzheimer's disease, the most common form of dementia.

Waves of Calcium

Using fluorescence imaging of purified astrocyte cells extracted from rat cortex tissue, the researchers imaged calcium signals rising and falling across networks of astrocytes. The calcium waves arose only after the researchers added Amyloid beta peptides to the astrocyte cultures.

"In the cultures of astrocytes where we have applied the amyloid beta, we see these huge scale calcium transients and changes spreading throughout the network. One cell will light up, and then all the cells around it will start lighting up -- a wave that maybe takes up 150 or 200 cells. That is an intercellular calcium wave and its propagation," explained bioengineering Ph.D. student Chris MacDonald from the UC San Diego Jacobs School of Engineering. MacDonald and Siu-Kei Chow (MS bioengineering, 2009) and Diana Yu (Ph.D., bioengineering 2009) share the first author position on the paper and contributed equally to this work.

"I look at the mechanistic interpretations of the data through mathematical modeling. We see what is happening, but the question is why. And to do that, we need to probe a little bit deeper. Why does amyloid beta cause these waves? We know it does, but why?," asked MacDonald. Answering this "why question" could help researchers finally understand what causes Alzheimer's disease.

Deep Neuroscience Questions

By tracking calcium waves in networks of brain cells, researchers can see changes in membrane voltage, which offers insights into how neurons and other brains cells, including astrocytes, communicate. A better understanding of how the brain works from this bottom-up perspective could lead researchers closer to answering some of the deepest questions in neuroscience. Calcium imaging is emerging as the primary method for interrogating the activity of cellular neural networks, explained Silva, whose Cellular Neural Engineering laboratory focuses, in part, on how information flows through networks of brain cells. According to Silva, answering some of the deepest questions in neuroscience -- like What are the origins of creativity, logical reasoning, consciousness and emotions? -- will require a better understanding of how information is processed by functional networks in the brains of humans and other species."We are just getting to the point where the math and engineering methods are starting to be developed to allow one to study brain networks at the scale of individual cells," said Silva. His lab collaborates with Henry Abarbanel's group in the Department of Physics at UC San Diego on mathematical modeling of neurophysiological systems and computational neuroscience.

In the *ASN NEURO* paper, the researchers used calcium imaging to study a purified astrocyte network. Meanwhile, novel complementary techniques, including "two photon optical microscopy" are raising the possibility of experimental tools capable of testing and validating new theories about how the brain functions from the perspective of cellular networks. This technology could also help researchers uncover how individual brain cells behave as signals propagate through a given network. The Silva lab collaborates with Anna Devor's Neurovascular Imaging Laboratory in the Department of Neuroscience at UC San Diego on experimental cellular imaging and neurophysiology.Today's fMRI (functional magnetic resonance imaging) tools are useful for studying the brain, but their spatial resolution is far too course to provide insights at the cellular level. "With fMRI, you have no information on what is happening at the individual circuit and network level," said Silva. With technologies such as two photon optical microscopy, researchers are aiming to uncover how the brain works in much finer detail.

Story Source:

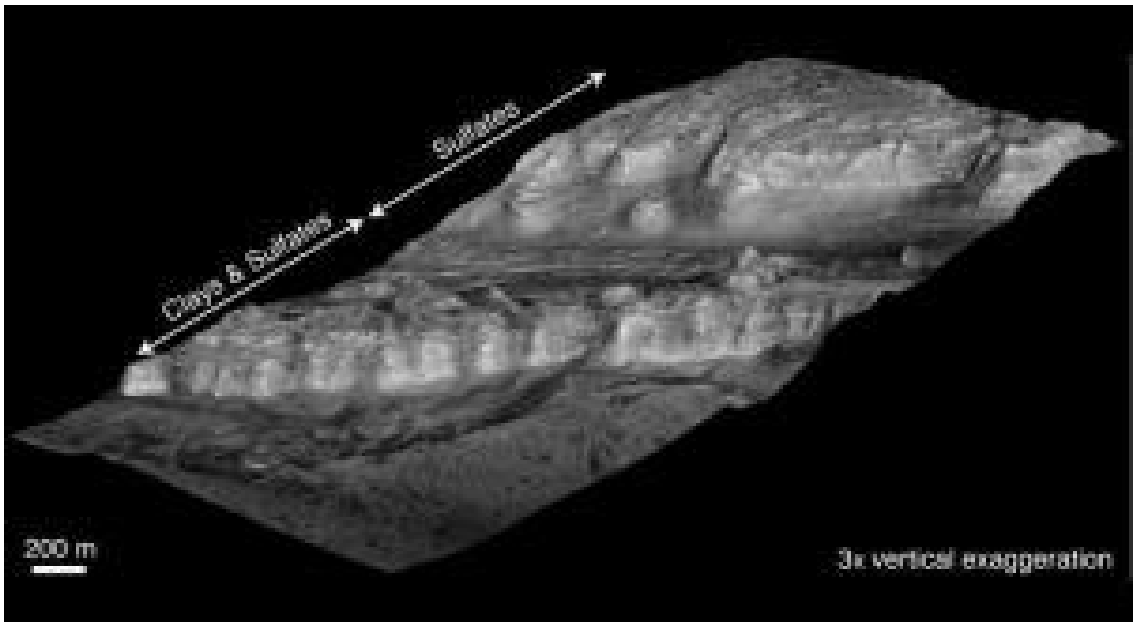
Adapted from materials provided by University of California - San Diego.

Journal Reference:

1. Chris MacDonald, Siu-Kei Chow and Diana Yu et al. **Amyloid-%u03B2 directly induces spontaneous calcium transients, delayed intercellular calcium waves, and gliosis in rat cortical astrocytes**. *ASN NEURO*, January 25, 2010 DOI: 10.1042/AN20090035

http://www.sciencedaily.com/releases/2010/02/100212172529.htm

Layers in a Mars Crater Record a History of Changes



This oblique view shows geological layers of rock exposed on a mound inside Gale Crater on Mars. (Credit: NASA/JPL-Caltech/University of Arizona/USGS)

ScienceDaily (Feb. 14, 2010) — Near the center of a Martian crater about the size of Connecticut, hundreds of exposed rock layers form a mound as tall as the Rockies and reveal a record of major environmental changes on Mars billions of years ago.

The history told by this tall parfait of layers inside Gale Crater matches what has been proposed in recent years as the dominant planet-wide pattern for early Mars, according to a new report by geologists using instruments on NASA's Mars Reconnaissance Orbiter.

"Looking at the layers from the bottom to the top, from the oldest to the youngest, you see a sequence of changing rocks that resulted from changes in environmental conditions through time," said Ralph Milliken of NASA's Jet Propulsion Laboratory, Pasadena, Calif. "This thick sequence of rocks appears to be showing different steps in the drying-out of Mars."

Using geological layers to understand stages in the evolution of a planet's climate has a precedent on Earth. A change about 1.8 billion years ago in the types of rock layers formed on Earth became a key to understanding a dramatic change in Earth's ancient atmosphere.

Milliken and two co-authors report in Geophysical Research Letters that clay minerals, which form under very wet conditions, are concentrated in layers near the bottom of the Gale stack. Above that, sulfate minerals are intermixed with the clays. Sulfates form in wet conditions and can be deposited when the water in which they are dissolved evaporates. Higher still are sulfate-containing layers without detectable clays. And at the top is a thick formation of regularly spaced layers bearing no detectable water-related minerals.

Rock exposures with compositions like various layers of the Gale stack have been mapped elsewhere on Mars, and researchers, including Jean-Pierre Bibring of the University of Paris, have proposed a Martian planetary chronology of clay-producing conditions followed by sulfate-producing conditions followed by dry conditions. However, Gale is the first location where a single series of layers has been found to contain these clues in a clearly defined sequence from older rocks to younger rocks.

"If you could stand there, you would see this beautiful formation of Martian sediments laid down in the past, a stratigraphic section that's more than twice the height of the Grand Canyon, though not as steep," said Bradley Thomson of the Johns Hopkins University Applied Physics Laboratory, Laurel, Md. He and John Grotzinger of the California Institute of Technology in Pasadena are Milliken's co-authors.

NASA selected Gale Crater in 2008 as one of four finalist sites for the Mars Science Laboratory rover, Curiosity, which has a planned launch in 2011. The finalist sites all have exposures of water-related minerals, and each has attributes that distinguish it from the others. This new report is an example of how observations made for evaluating the landing-site candidates are providing valuable science results even before the rover mission launches.

Three instruments on NASA's Mars Reconnaissance Orbiter have provided key data about the layered mound in Gale Crater. Images from the High Resolution Imaging Science Experiment camera reveal details used to map hundreds of layers. Using stereo pairs of the images, the U.S. Geological Survey has generated three-dimensional models used to discern elevation differences as small as a meter (about a yard). Observations by the Compact Reconnaissance Imaging Spectrometer for Mars yielded information about minerals on the surface. The Context Camera provided broader-scale images showing how the layers fit geologically into their surroundings.

Thomson said, "This work demonstrates the synergy of the instruments on the Mars Reconnaissance Orbiter. We wouldn't have as complete a picture if we were missing any of the components."

The mission has been studying Mars since 2006. It has returned more data from the planet than all other Mars missions combined.

Malin Space Science Systems, San Diego, provided and operates the Context Camera. Johns Hopkins University Applied Physics Laboratory provided and operates the Compact Reconnaissance Imaging Spectrometer. The University of Arizona Lunar and Planetary Laboratory, Tucson, operates the High Resolution Imaging Science Experiment, which was built by Ball Aerospace & Technologies Corp., Boulder, Colo.

Story Source:

Adapted from materials provided by NASA/Jet Propulsion Laboratory.

http://www.sciencedaily.com/releases/2010/02/100211152126.htm

Six Month Old Babies Can Understand Our Intentions

ScienceDaily (Feb. 14, 2010) — A study by York University researchers reveals that infants as young as six months old know when we're "playing" them -- and they don't like it.

Researchers in York's Centre for Infancy Studies examined six-and nine-month-old babies' reactions to a game in which an experimenter was either unable or unwilling to share a toy. Babies detected and calmly accepted when an experimenter was unable to share for reasons beyond her control, but averted their gazes and became agitated when it was clear she simply wouldn't share.

"Babies can tell if you're teasing or being manipulative, and they let you know it," says study lead author Heidi Marsh, a PhD student who worked under the direction of psychology professor Maria Legerstee, head of the Centre for Infancy Studies in York's Faculty of Health.

"These results are exciting as it's the first demonstration that used infants' social behaviour to successfully show that at six months they comprehend the goals of our actions. Previously, there was only evidence based on visual habituation (observing the pattern of infants' gazes towards stimuli) which is prone to interpretative issues, and even those results were very mixed," Marsh says.

Other studies have concluded that this ability doesn't develop until nine months of age. However, that research used measures which Marsh proposes are unsuited to younger infants.

"A six-month-old as compared to a nine-month-old has different ways of expressing what they know," says Marsh. "The innovative aspect of this research is that we used measures that are consistent with a six-month-old's everyday behaviour in order to understand what they comprehend. We recorded their social responses, such as sadness, gaze aversions, smiles and vocalizations, in addition to more physical responses such as reaching and banging," she says.

The study looked at 40 infants, evenly divided between genders. Infants sat in their mothers' laps at a table, with the experimenter seated across from them. In half the test trials, the toy was not passed to the infant because the experimenter was unwilling to share it, and in the others, it was not passed because the experimenter was trying, but unable, to pass it.

Infants were administered three tasks: block, mock, and play. Each task differed with respect to the toy that was shared, and the nature of the sharing game, but in all tasks there was a corresponding unwilling and unable condition. For instance, in the mock task, a rattle was held out toward the infant, and then pulled back teasingly (unwilling condition), and a ball was "accidentally" dropped and rolled back to the experimenter (unable condition).

The visible movements of both the experimenter and the toy were matched across conditions, as was the outcome that the toy was not shared. This meant that the main difference between conditions was the experimenter's intent.

"We also used the experimenter's facial expressions to convey unwillingness or inability, as they're important cues for babies to understand others' goals," says Marsh.

Infants at both ages averted their gazes during unwilling trials. They also reached more in the unable conditions, suggesting they understood there was a problem and were trying to elicit the adult's assistance. The nine-month-olds banged their arms in the unwilling conditions, whereas the six-month-olds showed more negative affect, such as frowns, in those trials, and positive affective behaviours in unable conditions.

"Our finding that affective measures are stronger for younger infants may be related to their level of independence," Marsh says. "As infants become more independent, they decrease affective behavior such

as crying, and increase physical actions such as actively resisting. These distinctions point to the importance of studying infants' social and cognitive abilities not only over time, but also in paradigms that capture the spectrum of their social behaviours."

This research was supported by grants from the Social Sciences and Humanities Research Council of Canada (SSHRC).

Story Source:

Adapted from materials provided by York University, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Heidi Marsh, Maria Legerstee, Jennifer Stavropoulos and Tom Nienhuis. **Six-and Nine-Month-Old Infants Discriminate Between Goals Despite Similar Action Patterns**. *Infancy*, January 2010

http://www.sciencedaily.com/releases/2010/02/100209183333.htm

Deep Sea Creatures Build Their Homes from Materials That Sink from Near the Ocean Surface

Evidence from the Challenger Deep -- the deepest surveyed point in the world's oceans -- suggests that tiny single-celled creatures called foraminifera living at extreme depths of more than ten kilometres build their homes using material that sinks down from near the ocean surface. (Credit: Image courtesy of JAMSTEC)

ScienceDaily (Feb. 14, 2010) — Evidence from the Challenger Deep -- the deepest surveyed point in the world's oceans -- suggests that tiny single-celled creatures called foraminifera living at extreme depths of more than ten kilometres build their homes using material that sinks down from near the ocean surface.

The Challenger Deep is located in the Mariana Trench in the western Pacific Ocean. It lies in the hadal zone beyond the abyssal zone, and plunges down to a water depth of around 11 kilometres.

"The hadal zone extends from around six kilometres to the deepest seafloor. Although the deepest parts of the deepest trenches are pretty inhospitable environments, at least for some types of organism, certain kinds of foraminifera are common in the bottom sediments," said Professor Andrew Gooday of the National Oceanography Centre, Southampton (NOCS) and member of a UK-Japanese team studying these organisms in samples collected in 2002 during a Japan-USA-Korea expedition to study life in the western depression of the Challenger Deep.

The researchers, whose findings appear in the latest issue of the journal *Deep Sea Research*, used the remotely operated vehicle KAIKO, operated by the Japan Agency for Marine-Earth Science and Technology (JAMSTEC), to take core samples from the soft sediment of the trench floor. Among many foraminiferans with an organic shell (or 'test'), they found four undescribed specimens with agglutinated tests.

"The Challenger Deep is an extreme environment for agglutinated foraminifera, which construct their tests from a wide range of particles cemented together by calcareous or organic matter," said Gooday. "At these great depths, particles made from biologically formed calcite and silica, as well as minerals such as quartz, should dissolve, leaving only clay grains available for test building."

The researchers were therefore surprised to discover that foraminiferan tests sampled from the Challenger Deep contained calcareous components, including the dissolved remnants of coccoliths, the calcium carbonate plates of tiny algae called coccolithophores, and planktonic foraminiferan test fragments.

The organic test surface of one species was densely pitted with imprints, which the researchers interpreted as representing mineral grains of various types, including quartz, which subsequently dissolved. Agglutinated particles, presumed to be clay minerals, survived only in one specimen.

"Our observations demonstrate that coccoliths, and probably also planktonic foraminiferan tests, reach the Challenger Deep intact," said Gooday. "These particles were probably transported to these extreme depths in rapidly sinking marine snow, the aggregated remains of phytoplankton that lived in the sunlit surface ocean, or in faecal pellets from zooplankton."

It seems likely, therefore, that at least some agglutinated foraminifera living at extreme hadal depths build their homes from material that sinks down from the ocean above, rather like manna from heaven.

This study was supported by the Japan Society for the Promotion of Science and the OCEANS 2025 Strategic Research Programme of the UK Natural Environment Research Council.

The researchers are Andrew Gooday (NOCS), K. Uematsu (Marine Works Japan Ltd, Yokosuka, Japan), H. Kitazato & T. Toyofuku (JAMSTEC), and J. R. Young (Natural History Museum, London).

Story Source:

Adapted from materials provided by National Oceanography Centre, Southampton (UK).

Journal Reference:

1. Gooday, A. J., Uematsu, K., Kitazato, H., Toyofuku, T. & Young, J. R. **Traces of dissolved particles, including coccoliths, in the tests of agglutinated foraminifera from the Challenger Deep (10,897 m water depth, western equatorial Pacific)**. *Deep Sea Research Part I: Oceanographic Research Papers*, 57(2), 239-247 (2010) DOI: 10.1016/j.dsr.2009.11.003

http://www.sciencedaily.com/releases/2010/02/100211100758.htm

A Potent Suppressor of Endometrial Cancer Is Revealed

ScienceDaily (Feb. 14, 2010) — Endometrial cancer is the most common cancer of the female reproductive tract, representing 6% of all cancers. There is currently no screening method or biomarker to indicate early presence of disease. "It is a very common malignancy that affects women of all ages" comments paper author Dr. Diego Castrillon. The cancer forms from the cells that grow along the inner lining of the uterus, which is called the endometrium, and usually it is diagnosed following patient reports of abnormal bleeding.The normal endometrium is a dynamic place, providing a thick, highly vascularized environment ready to generate a placenta if it is implanted with an embryo. The dynamic and cyclic activity of the endometrium makes it very sensitive to signaling molecules. Early changes in a number of signaling proteins are known to contribute to endometrial cancer in some patients. A major research goal is to understand how signals create cancer cells and to identify places where intervention might shut down the signals that promote cancer cell survival and growth.

Researchers learn about cancer by creating genetic changes to signaling proteins in mice that reflect changes found in human cancer patients. Animal models are produced in this way to help understand how cancer cells form and progress. One challenge is to localize genetic changes to the environment of interest. In the case of endometrial cancer, researchers need to specifically modify only those cells that are in the endometrium, so that their data is not complicated by changes in other tissues.

In a new study published in *Disease Models & Mechanisms* (DMM), scientists report a new genetic tool that can specifically alter gene expression in the endometrium. They use this approach to remove a signaling protein gene only in endometrial cells to determine its influence on endometrial cancer formation. They found that the genetic change induced a very rapidly progressing cancer in all mice that carried the mutation. The gene they deleted, called Lkb1, is mutated in many other types of human cancers, and it regulates pathways that are known to contribute to the formation of aggressive cancer cells.Very few genetic changes act alone to induce cancer. Most cancer cells result from multiple mutations. However, all mice deficient for just Lkb1, exhibited cancerous changes throughout their entire endometrium. "In most mouse cancer models, one creates a tumor prone condition. But additional mutations are usually required for a cell to develop a cancer" says Dr. Castrillon, "What is surprising about the Lkb1 model, is that their entire endometrium becomes malignant. It happens very early and rapidly."

The rapid development of cancer in mice without Lkb1 suggests that this gene or the molecules that its product regulates may be valuable targets for future therapy. The authors show that treating the mice with a drug that blocks a downstream target of the Lkb1 product kills tumor cells, leading to tumor shrinkage and dramatic recovery of the mice. "It is likely that this pathway is very important. We believe that Lkb1 mutations or mutations in other steps in this pathway represent some type of metabolic abnormality that we could take advantage of [for therapeutic intervention]" says Dr. Castrillon.

Adapted from materials provided by The Company of Biologists, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Cristina M. Contreras, Esra A. Akbay, Teresa D. Gallardo, Marshall Haynie, Osamu Tagao, Masaya Takahashi, Diego H. Castrillon, and Sreenath Sharma, Nabeel Bardeesy, Jeff Settleman and Kwok-Kin Wong. **Lkb1 inactivation is sufficient to drive endometrial cancers that are aggressive yet highly responsive to mTOR inhibitor monotherapy**. *Disease Models & Mechanisms*, March/April issue of 2010 (Vol 3/Issue 3-4)

http://www.sciencedaily.com/releases/2010/02/100208091912.htm

Breakthrough for Mobile Television

ScienceDaily (Feb. 14, 2010) — Long Term Evolution, a new mobile telecommunications standard, is poised to revolutionize mobile Internet. High transmission rates will soon be possible on mobile devices. For this purpose Fraunhofer researchers at HHI Berlin developed the cross-layer design SVC over LTE -- a coding method that offers HD films in real-time in the appropriate format for cell phones or netbooks.

The experts are presenting their solution in a live demonstration at the Mobile World Congress in Barcelona.

Clumsy page layouts, slow page load times of podcasts and videos: Today's mobile surfing on the Internet can be really a hassle. The available bandwidths on mobile phone networks vary widely, due to the number and mobility of the users, the location within the mobile network cell, or the capacity of the terminal. Particularly in bandwidth-intensive services, like video streaming, transmissions are frequently subject to disconnections, gaps or interruptions.

The mobile telecommunications standard of tomorrow -- Long Term Evolution, or LTE for short -- will change everything. It has a higher performance capacity than UMTS, and reaches download speeds being comparable to landline-based DSL broadband network. Not only e-mails and Internet traffic, particularly videos and mobile television benefit from LTE as the breakthrough for mobile Internet technology.

The "Multicore SVC Real-time Encoder" encodes a basic version of the video, the base layer, and places several enhancement layers in the SVC bit stream next to the base layer in one single processing step. Partial decoding of the scalable bit stream allows graceful degradation and bit rate, format and power adaptation. LTE can now use a higher error protection to transmit the base layer. Thus, each mobile terminal can always decode the basic version of the video stream and guarantees the transmission of video services everywhere and for every given point of time. Under good network conditions, the mobile user can benefit from premium video quality by decoding additional enhancement layers.

The cross-layer design SVC over LTE, an invention by the scientists at the Fraunhofer Institute for Telecommunications, Heinrich Hertz Institute HHI in Berlin, are making high-resolution video encoding over LTE a reality. "SVC over LTE" responds to variable user demands with great flexibility, and enables for the first time seamless adaptive communication without annoying disruptions. Current postage stamp-sized, hiccupping video streams will be a thing of the past.

Story Source:

Adapted from materials provided by Fraunhofer-Gesellschaft.

http://www.sciencedaily.com/releases/2010/02/100212101253.htm

Assistive Technology Helps Dementia Sufferers Get Through the Day

ScienceDaily (Feb. 14, 2010) — Tens of millions of elderly people in the EU suffering from mild dementia may be able to look after themselves, and free up their carers, thanks to a new European-developed system.

One of the first and most debilitating symptoms of dementia is short-term memory loss, which means care is required for people who are otherwise quite capable of looking after themselves. They can perform tasks, but they forget them or how to do them.

Other symptoms of mild dementia can be linked to a loss of self-confidence -- old people increasingly refraining from initiating social contact -- and to a sense of insecurity.

How to address these concerns and enable mild dementia victims to continue to lead independent lives for an extended period of time has been researched, and possibly solved, by an EU-funded project.

The COGKNOW project brought together some of the leading dementia specialists in Europe, doctors from the Netherlands, Sweden and Northern Ireland, with teams of software researchers and developers. Their aim was to address a range of different needs of mild dementia patients and come up with a simple, user-friendly device to meet those needs.

Need for simple-to-use devices

"Separate devices and solutions exist for many of the needs, and if people learn how to use them early on, then they may be able to continue using them quite far into the disease" says the project's scientific coordinator Johan E Bengtsson. "But it then becomes a problem for the patient to remember where the devices are, and how each of them works," he says. Also, in later stages of the disease, simplified devices are needed, and at that stage it is usually too late to teach anybody how to use even the simpler devices and the person will then need to rely on a carer.

So the COGKNOW project set out to create two very user-friendly devices, one home-based and one mobile, featuring all the high-priority and previously unmet needs, as identified by end users and their carers, as well as the dementia experts.

They determined that touch-screen technology was the ideal interface between persons with dementia and computer-based assistive functions. An added attraction was the fact that they could buy the needed hardware devices off the shelf and then install the COGKNOW Day Navigator software suite on them.

Self-explanatory icons

The end result was a flat-screen monitor for the home, which can be either wall mounted or standalone, and a mobile smart phone with a much simplified user interface installed.

Both devices are controlled solely by touch screen (the monitor does not even come with a keyboard) with the COGKNOW application maintained on top of everything so nothing else is visible to the end user. "The application takes control of the device and makes it impossible for the user to activate the more difficult-to-use functions of these devices," explains Bengtsson.

All the user has to deal with are simple, self-explanatory icons on the touch screen. The in-home system can be set up to start issuing reminders from wake-up time in the morning until bed time. These can be recorded in a friend or relative's voice, and give instructions for all sorts of activities such as picking up the morning newspaper, brushing teeth, preparing or warming pre-prepared meals, laundry and dish washing and myriad other daily activities.

They can also be linked to video presentations showing how to operate, for example, the stove, microwave oven or washing machine.

Many elderly people worry if the door is open or unlocked, and the COGKNOW system monitors this so they don't keep on checking that during the day. On-screen icons in the form of photos help them to picture-dial friends and relatives, simply by touching a particular photo.

Coping with getting lost

Most functions are also included on the mobile device, which comes with an important extra GPS-based feature. Dementia sufferers can get disoriented when out, and the device can guide them home whenever necessary.

The system was field-tested on user groups in three countries, and the majority of users and carers perceived significant improvement in their lives and their ability to get through the day.

Now some members of the project, which finished last August, are working to commercialise the system and market it around Europe. "About two per cent of the population of Europe suffers from mild dementia and it costs an estimated €10,000 a year to provide care for each of them when they cannot cope anymore."

"Our devices will cost a lot less than that, and can be used again by other people when the first owner progresses too far into the disease," says Bengtsson. "If COGKNOW only extends people's ability to look after themselves for an extra few months, then the savings are still potentially billions of euros."

The COGKNOW consortium is looking for new partners to help with commercialisation and marketing in the shape of an established software provider, preferably with experience in mobile applications, and companies specialising in reselling and providing solutions to the care and medical sectors in individual countries or groups of countries.

Story Source:

Adapted from materials provided by ICT Results.

http://www.sciencedaily.com/releases/2010/02/100209124356.htm

New Picture of Ancient Ocean Chemistry Argues for Chemically Layered Water

The Ediacaran Doushantuo Formation and overlying Dengying Formation crop out in the background above the Yangtze River near Yichang city and the Three Gorges Dam, Hubei Province, China. (Credit: Chao Li, UC Riverside)

ScienceDaily (Feb. 13, 2010) — A research team led by biogeochemists at the University of California, Riverside has developed a detailed and dynamic three-dimensional model of Earth's early ocean chemistry that can significantly advance our understanding of how early animal life evolved on the planet.

Working on rock samples from the Doushantuo Formation of South China, one of the oldest fossil beds and long viewed by paleontologists to be a window to early animal evolution, the research team is the first to show that Earth's early ocean chemistry during a large portion of the Ediacaran Period (635-551 million years ago) was far more complex than previously imagined.

Their work is the first comprehensive geochemical study of the Doushantuo Formation to investigate the structure of the ocean going from shallow to deep water environments. It is also one of the most comprehensive studies for any Precambrian interval. (The Precambrian refers to a stretch of time spanning from the inception of the Earth approximately 4.5 billion years ago to about 540 million years ago. It was in the Precambrian when the first single-celled microbes evolved 3.5 billion years ago or earlier, followed by the first multicellular animals much later, around 700 million years ago.)

The researchers' model for the ancient ocean argues for a stratified marine basin, one with a chemically layered water column. While the surface ocean was oxygen-rich, the deep ocean was ferruginous -- oxygen-deprived and iron-dominated. Further, sandwiched in this deep ocean was a dynamic wedge of sulfidic water, highly toxic to animal life, that impinged against the continental shelf.

Dominated by dissolved hydrogen sulfide, the sulfidic wedge was in a state of flux, varying in size and capable of encroaching on previously oxygenated areas of the continental shelf -- killing all animal life there. The overall picture is a marine basin with co-existing oxygen-rich, sulfidic and ferruginous water layers.

Study results appear Feb. 11 in *Science Express*.

In the modern sulfur-rich ocean, hydrogen sulfide in oxygen-poor waters reacts with iron to form the mineral pyrite, thus stripping the dissolved iron from the water column. But the researchers' results show that under specific geochemical conditions in the early ocean, when levels of dissolved sulfate (the source of hydrogen sulfide in the ocean) and oxygen were particularly low compared to the modern ocean, layers of sulfidic waters could coexist with ferruginous water masses, and even persist for long periods of time.

"This is an entirely new interpretation of ancient ocean chemistry," said Chao Li, a research specialist in UC Riverside's Department of Earth Sciences and the first/lead author of the research paper. "Our model provides a brand-new backdrop for the earliest evolution of animal life on the planet. We show that the sulfidic ocean wedge, along with an absence of oxygen, can hinder the colonization of early animals on the shallow seafloor and influence their evolution as they take a foothold. In other words, we cannot ignore hydrogen sulfide when piecing together how animals and other eukaryotes such as algae evolved on our planet."

The researchers posit that their robust pattern of a stratified marine basin is the best example of a new paradigm in studies of Precambrian ocean chemistry. They predict the record of much of the early ocean elsewhere will show similarities to the complex chemical layering seen in South China.

"This new world order asks that we take into account co-occurring spatial variations in water chemistry in an ocean basin, specifically when moving from near the shallow shoreline along continental shelves to progressively outwards into deeper waters, and when applying a diverse range of complementary geochemical analyses to elucidate these changes in ocean chemistry," said Gordon Love, an assistant professor of biogeochemistry, who collaborated on the study and in whose lab Li works.

Li explained that in the scientific literature the generally patchy fossil record of early animals observed through the Ediacaran has largely been attributed to poor preservation of fossils. The new research shows, however, that changes in environmental conditions, in this case variations in distribution of hydrogen sulfide, may explain gaps seen in the Ediacaran fossil record.

"Our model points to early animal life having to cope with changing chemical environments even in the shallow waters of the continental shelf," said Love, the principal investigator on the National Science Foundation (NSF) grant that funded the study. "At times, movement of toxic sulfide-rich waters into the shallow water would be calamitous to animal life. This well explains the patchy time record of animal fossils in most Ediacaran basins."

Timothy Lyons, a professor of biogeochemistry and a co-principal investigator on the NSF grant, explained that only an incomplete temporal record of animal microfossils has been unearthed in the Doushantuo Formation despite considerable efforts.

"Much of the unequivocal fossil evidence for animals is in the form of microfossil cysts found in only a few sedimentary layers, suggesting that the early animals were environmentally stressed," he said. "An explanation for this pattern is certain to lie in our model."

According to the researchers, a stratified marine basin was favored by an overall deficiency of dissolved sulfate in seawater following a long history of oxygen deficiency in the ocean. Ordinarily, sulfate gets introduced into the ocean from the weathering of continental sulfide minerals exposed to an atmosphere with photosynthetically produced oxygen. But the researchers argue that major glaciation events

predating Doushantuo time exacerbated the scarcity of sulfate. They note that if glaciation was globally extensive, gas and chemical interactions between the oceans and atmosphere would be suppressed by a layer of ice cover in many areas.

"Ocean chemistry changes as the ice coverage acts like a pie crust sealing off the ocean interior from the atmosphere," Love said. "The effects of such ice coverage are a reduction of sulfate inputs into the ocean brought in by rivers and a buildup of dissolved iron in the deep ocean sourced by volcanic activity along the mid-ocean ridges. Later, as the ice cover abated, sulfate inputs from rivers localized the animal-inhibiting wedge of hydrogen sulfide along the shallow basin margins."

Li, Love and Lyons were joined in the study by David A. Fike at Washington University in St. Louis, Mo.; Alex L. Sessions at the California Institute of Technology; and Xuelei Chu at the Chinese Academy of Sciences, Beijing.

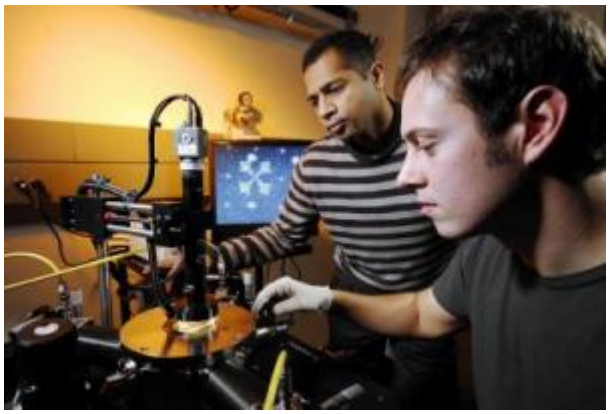
Besides the NSF, the Agouron Institute funded the study.

Story Source:

Adapted from materials provided by University of California - Riverside, via EurekAlert!, a service of AAAS.

http://www.sciencedaily.com/releases/2010/02/100211141136.htm

Single-Step Technique Produces Both P-Type and N-Type Doping for Future Graphene Devices



Researchers Raghunath Murali and graduate student Kevin Brenner (front) perform electrical measurements on a graphene sample under high vacuum in a cryogenic probe station. (Credit: Georgia Tech Photo: Gary Meek)

ScienceDaily (Feb. 13, 2010) — A simple one-step process that produces both n-type and p-type doping of large-area graphene surfaces could facilitate use of the promising material for future electronic devices. The doping technique can also be used to increase conductivity in graphene nanoribbons used for interconnects.

By applying a commercially-available spin-on-glass (SOG) material to graphene and then exposing it to electron-beam radiation, researchers at the Georgia Institute of Technology created both types of doping by simply varying the exposure time. Higher levels of e-beam energy produced p-type areas, while lower levels produced n-type areas.

The technique was used to fabricate high-resolution p-n junctions. When properly passivated, the doping created by the SOG is expected to remain indefinitely in the graphene sheets studied by the researchers.

"This is an enabling step toward making possible complementary metal oxide graphene transistors," said Raghunath Murali, a senior research engineer in Georgia Tech's Nanotechnology Research Center.

A paper describing the technique appears this week in the journal *Applied Physics Letters.* The research was supported by the Semiconductor Research Corporation and the Defense Advanced Research Projects Agency (DARPA) through the Interconnect Focus Center.

In the new doping process, Murali and graduate student Kevin Brenner begin by removing flakes of graphene one to four layers thick from a block of graphite. They place the material onto a surface of oxidized silicon, then fabricate a four-point contact device.

Next, they spin on films of hydrogen silsesquoxane (HSQ), then cure certain portions of the resulting thin film using electron beam radiation. The technique provides precise control over the amount of radiation and where it is applied to the graphene, with higher levels of energy corresponding to more cross-linking of the HSQ.

"We gave varying doses of electron-beam radiation and then studied how it influenced the properties of carriers in the graphene lattice," Murali said. "The e-beam gave us a fine range of control that could be valuable for fabricating nanoscale devices. We can use an electron beam with a diameter of four or five nanometers that allows very precise doping patterns."

Electronic measurements showed that a graphene p-n junction created by the new technique had large energy separations, indicating strong doping effects, he added.

Researchers elsewhere have demonstrated graphene doping using a variety of processes including soaking the material in various solutions and exposing it to a variety of gases. The Georgia Tech process is believed to be the first to provide both electron and hole doping from a single dopant material.

Doping processes used for graphene are likely to be significantly different from those established for silicon use, Murali said. In silicon, the doping step substitutes atoms of a different material for silicon atoms in the material's lattice.

In the new single-step process for graphene, the doping is believed to introduce atoms of hydrogen and oxygen in the vicinity of the carbon lattice. The oxygen and hydrogen don't replace carbon atoms, but instead occupy locations atop the lattice structure.

"Energy applied to the SOG breaks chemical bonds and releases hydrogen and oxygen which bond with the carbon lattice," Murali said. "A high e-beam energy converts the whole SOG structure to more of a network, and then you have more oxygen than hydrogen, resulting in a p-type doping."

In volume manufacturing, the electron beam radiation would likely be replaced by a conventional lithography process, Murali said. Varying the reflectance or transmission of the mask set would control the amount of radiation reaching the SOG, and that would determine whether n-type or p-type areas are created.

"Making everything in a single step would avoid some of the expensive lithography steps," he said. "Gray-scale lithography would allow fine control of doping across the entire surface of the wafer."

For doping bulk areas such as interconnects that do not require patterning, the researchers simply coat the area with HSQ and expose it to a plasma source. The technique can make the nanoribbons up to 10 times more conductive than untreated graphene.

Because HSQ is already familiar to the microelectronics industry, the one-step approach to doping could help integrate graphene into existing processes, avoiding a disruption of the massive semiconductor design and fabrication system, Murali noted.

Over the past two years, researchers in the Nanotechnology Research Center had observed changes caused by application of HSQ during electrical testing. Only recently did they take a closer look at what was happening to understand how to take advantage of the phenomenon.

For the future, they'd like to better understand how the process works and whether other polymers might provide better results.

"We need to have a better understanding of how to control this process because variability is one of the issues that must be controlled to make manufacturing feasible," Murali explained. "We are trying to identify other polymers that may provide better control or stronger doping levels."

Story Source:

Adapted from materials provided by Georgia Institute of Technology.

http://www.sciencedaily.com/releases/2010/02/100211163122.htm

Don't Touch That Dial!

A history of media technology scares, from the printing press to Facebook.

By Vaughan Bell
POSTED MONDAY, FEB. 15, 2010, AT 7:00 AM ET

A respected Swiss scientist, Conrad Gessner, might have been the first to raise the alarm about the effects of information overload. In a landmark book, he described how the modern world overwhelmed people with data and that this overabundance was both "confusing and harmful" to the mind. The media now echo his concerns with reports on the unprecedented risks of living in an "always on" digital environment. It's worth noting that Gessner, for his part, never once used e-mail and was completely ignorant about computers. That's not because he was a technophobe but because he died in 1565. His warnings referred to the seemingly unmanageable flood of information unleashed by the printing press.

Worries about information overload are as old as information itself, with each generation reimagining the dangerous impacts of technology on mind and brain. From a historical perspective, what strikes home is not the evolution of these social concerns, but their similarity from one century to the next, to the point where they arrive anew with little having changed except the label.

These concerns stretch back to the birth of literacy itself. In parallel with modern concerns about children's overuse of technology, Socrates famously warned against writing because it would "create forgetfulness in the learners' souls, because they will not use their memories." He also advised that children can't distinguish fantasy from reality, so parents should only allow them to hear wholesome allegories and not "improper" tales, lest their development go astray. The Socratic warning has been repeated many times since: The older generation warns against a new technology and bemoans that society is abandoning the "wholesome" media it grew up with, seemingly unaware that this same technology was considered to be harmful when first introduced.

Gessner's anxieties over psychological strain arose when he set about the task of compiling an index of every available book in the 16th century, eventually published as the *Bibliotheca universalis*. Similar concerns arose in the 18th century, when newspapers became more common. The French statesman Malesherbes railed against the fashion for getting news from the printed page, arguing that it socially isolated readers and detracted from the spiritually uplifting group practice of getting news from the pulpit. A hundred years later, as literacy became essential and schools were widely introduced, the curmudgeons turned against education for being unnatural and a risk to mental health. An 1883 article in the weekly medical journal the *Sanitarian* argued that schools "exhaust the children's brains and nervous systems with complex and multiple studies, and ruin their bodies by protracted imprisonment." Meanwhile, excessive study was considered a leading cause of madness by the medical community.

When radio arrived, we discovered yet another scourge of the young: The wireless was accused of distracting children from reading and diminishing performance in school, both of which were now considered to be appropriate and wholesome. In 1936, the music magazine the *Gramophone* reported that children had "developed the habit of dividing attention between the humdrum preparation of their school assignments and the compelling excitement of the loudspeaker" and described how the radio programs were disturbing the balance of their excitable minds. The television caused widespread concern as well: Media historian Ellen Wartella has noted how "opponents voiced concerns about how television might hurt radio, conversation, reading, and the patterns of family living and result in the further vulgarization of American culture."

By the end of the 20th century, personal computers had entered our homes, the Internet was a global phenomenon, and almost identical worries were widely broadcast through chilling headlines: CNN reported that "Email 'hurts IQ more than pot'," the *Telegraph* that "Twitter and Facebook could harm moral values" and the "Facebook and MySpace generation 'cannot form relationships'," and the *Daily Mail* ran a piece on "How using Facebook could raise your risk of cancer." Not a single shred of evidence

underlies these stories, but they make headlines across the world because they echo our recurrent fears about new technology.

These fears have also appeared in feature articles for more serious publications: Nicolas Carr's influential article "Is Google Making Us Stupid?" for the *Atlantic* suggested the Internet was sapping our attention and stunting our reasoning; the *Times* of London article "Warning: brain overload" said digital technology is damaging our ability to empathize; and a piece in the *New York Times* titled "The Lure of Data: Is It Addictive?" raised the question of whether technology could be causing attention deficit disorder. All of these pieces have one thing in common—they mention not one study on how digital technology is affecting the mind and brain. They tell anecdotes about people who believe they can no longer concentrate, talk to scientists doing peripherally related work, and that's it. Imagine if the situation in Afghanistan were discussed in a similar way. You could write 4,000 words for a major media outlet without ever mentioning a relevant fact about the war. Instead, you'd base your thesis on the opinions of your friends and the guy down the street who works in the kebab shop. He's actually from Turkey, but it's all the same, though, isn't it?

There is, in fact, a host of research that directly tackles these issues. To date, studies suggest there is no consistent evidence that the Internet causes mental problems. If anything, the data show that people who use social networking sites actually tend to have better offline social lives, while those who play computer games are better than nongamers at absorbing and reacting to information with no loss of accuracy or increased impulsiveness. In contrast, the accumulation of many years of evidence suggests that heavy television viewing does appear to have a negative effect on our health and our ability to concentrate. We almost never hear about these sorts of studies anymore because television is old hat, technology scares need to be novel, and evidence that something is safe just doesn't make the grade in the shock-horror media agenda.

The writer Douglas Adams observed how technology that existed when we were born seems normal, anything that is developed before we turn 35 is exciting, and whatever comes after that is treated with suspicion. This is not to say all media technologies are harmless, and there is an important debate to be had about how new developments affect our bodies and minds. But history has shown that we rarely consider these effects in anything except the most superficial terms because our suspicions get the better of us. In retrospect, the debates about whether schooling dulls the brain or whether newspapers damage the fabric of society seem peculiar, but our children will undoubtedly feel the same about the technology scares we entertain now. It won't be long until they start the cycle anew.

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The Irresistible Baconator

Why fast food calorie counts might not make people eat better.

By Sarah Elizabeth Richards
POSTED TUESDAY, FEB. 16, 2010, AT 9:35 AM ET

If you're having trouble sticking to your New Year's diet resolutions, a new German study could explain why. You might be sick of tracking and calculating what you're eating. The report released this month in the journal *Appetite* found that people had a harder time adhering to diets that seemed complicated than to programs that were simpler to follow.

The conclusion doesn't bode well for the growing public health trend of requiring chain restaurants to inform consumers about how many calories are in their food. Several cities already mandate that calorie counts be posted on boards or printed on menus, and five state legislatures have passed similar policies, according to the Center for Science in the Public Interest. In the supermarket, the Food and Drug Administration is urging food manufacturers to move calorie totals from the back of products to the front, where shoppers can't help but notice them. The idea is that having more access to nutrition information helps us make healthier choices. If people just knew that a Wendy's Baconator had 970 calories, the reasoning goes, they wouldn't eat them, and they'd be a lot thinner.

But that's not always the case, as calorie counts are irrelevant for consumers who don't know how many calories they're supposed to be eating in a day. A surprising number of people still don't, says Rebecca Krukowski, assistant professor of public health at the University of Arkansas for Medical Sciences. During a previous poll in Vermont, respondents' estimates ranged from 10 to 10,000 calories. The default government recommendation is 2,000 calories per day, but that can vary widely according to gender, age, and fitness level.

For those of us who know exactly how many calories we're supposed to be eating, putting a food's calorie content in our faces doesn't seem to consistently help us resist our favorite treats. Chalk it up to the lack of will power, sway of culture, or love of the processed carb, but humans aren't always rational eaters. A Stanford study found that Starbucks customers in New York City bought 14 percent fewer calories from food after a calorie-posting law was passed in April 2008. But they returned to their old cranberry bliss bar habits over the holidays—New Yorkers ate just as many calories as Philadelphia Starbucks customers (who didn't have calorie postings) around Christmas. New York University and Yale researchers found that customers in poor New York City neighborhoods with high rates of obesity purchased roughly the same number of calories from four fast-food chains, where calorie counts were visible, as their neighbors in Newark, N.J., where there was no posting law.

It can also be hard to take the counts seriously when you're not even sure they're accurate. Disciples of frozen-dessert chains Tasti D-Lite and CremaLita in New York City were aghast to learn that the calories in their cups of soft-serve were grossly underestimated. A Tufts report released last month found that many of the listed calorie contents of the food sold in 29 chain restaurants as well as 10 supermarket frozen meals were underestimated by as much as 20 percent on average. Fake ice cream scandals aside, experts say most calorie counts are in the ballpark. Still, you can't completely be sure you're getting what you think you are, especially if food establishments are self-reporting the numbers. Did their estimates include a realistic amount of salad dressing? Parmesan on your pasta? A generous dollop of special sauce on your Big Mac?

Advocates of a national calorie posting law say increased regulation would result in standardized—and hopefully more accurate—numbers. There's even a provision for one in the federal health care reform bill. That means we can expect to see many more shockingly high-calorie items excoriated on the *Today* show, like the Olive Garden's 1,030-calorie lasagna frittata. The honesty is refreshing, since restaurants won't be able to downplay the caloric content of a menu item by chopping it up into suggested servings, the way Coca-Cola says a 20-ounce bottle of Coke, which *looks* like one serving, is actually 2.5 servings, explains

Margo Wootan, director of nutrition policy at the Center for Science in the Public Interest. Currently, most regional and state restaurant posting laws already require establishments to post the calorie count of the whole enchilada—even if many restaurant entrées are so large they could feed the whole table.

"People can do the math themselves and divide the items," Wootan suggests. But incorporating such items into a healthy eating plan isn't so easy, especially if there aren't healthier alternatives. It's a guessing game—and a hassle. Does the Olive Garden's mass of cheesy goodness serve two or three people? Will your share be filling enough? Should you ask your waiter to split an entrée in the kitchen or bring extra plates? As the German study showed, making people do more calculations is not the best approach to combatting obesity.

There are some promising signs the math may soon become easier. Many restaurant executives have become so embarrassed by their hefty calorie counts that they're revamping their menus to offer more low-calorie choices. And the FDA, as part of its new labeling movement, is asking manufacturers to rejigger their listed serving sizes to reflect amounts that consumers realistically eat. (Note to Ben & Jerry: People don't actually eat a half-cup of Karamel Sutra.) Still, the surest way to control your weight, experts say, is to develop a sense of what's best for your body so you don't have to depend on the government or a corporation to tell you what's OK to eat. There are no surprises here: Watch portions, eat more fruits and vegetables, cut back on white flour and sugar, learn that a serving of meat is the size of your palm and that a single pancake portion is the diameter of a CD.

Following such principles might be the key to alleviating food math anxiety and helping you keep your dieting resolutions. It's worth a shot, because the list of things to keep track of—in addition to saturated fats, carbs, sugar, fiber—keeps growing. Next on the government's hit list: salt.

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Sarah Elizabeth Richards is the author of Motherhood, Rescheduled, *a narrative account of how egg freezing affected the lives of five women, to be published in summer 2010.*

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Sea Trash

Should we bother cleaning up the Great Pacific Garbage Patch?

By Nina Shen Rastogi
UPDATED TUESDAY, FEB. 9, 2010, AT 7:57 AM ET

I keep reading about the Great Pacific Garbage Patch, that floating island of trash between California and Hawaii. Can we ever clean it up? And should we even bother?

The Lantern always thought the Garbage Patch was a huge, waterborne landfill—sort of like a massive hair clog in a big drain. In reality, it's not so much an island of trash as a thin, soupy area of litter, mostly in the form of tiny flecks of plastic, studded here and there with old fishing gear and children's toys. (It's also not the only trashy area in the Pacific.) Even if you were to sail right through the Patch, the water itself probably wouldn't look too remarkable, unless you scooped some up and looked at it closely. So cleaning up this part of the ocean isn't as simple as you might have imagined.

Because the trash is so dispersed, it's not like we can just steer a big ship out to sea and pick up the Garbage Patch. Collecting all those small fragments of plastic would be extremely expensive. Plus, thanks to a variety of factors—from winter storms to El Niño—the Garbage Patch moves from season to season and year to year, making it hard to target effectively. Finally, in gathering up those little scraps, you also run the risk of catching—and killing—any marine animals living amid the debris, many of which are the same size as the plastic bits.

For all these reasons, most organizations stress that the best way to keep oceans clean is to prevent garbage from getting there in the first place. The Lantern does know of one group that's actively testing methods for removing trash from the open seas: the San Francisco- and Hong Kong-based Project Kaisei. In the expeditions it's planning for 2010, Project Kaisei will focus on picking out big, derelict fishing nets, which can snarl up marine life in a process known as "ghostfishing." It's also planning to use modified purse seines—large nets used by commercial fishing operations—to collect the medium-sized pieces of garbage floating near the surface of the water. Finally, the project will continue to experiment with methods of gathering the smaller bits of debris, though co-founder Mary Crowley notes that this part of the puzzle is still very much in the R&D phase.

Kaisei—which receives some of its funding from a recycling trade organization—is also looking for ways to squeeze value from the trash it collects. Currently, the group is focusing on methods that use pyrolysis—in which heat is used to break down materials in the absence of oxygen—to transform the collected waste into fuel. Some experts, however, are skeptical that this particular solution will make economic sense.

Meanwhile, we ought to know a lot more about the Garbage Patch—and ocean trash in general—before making a decision as to whether large-scale cleanup operations are viable or even warranted. There are still a lot of basic questions that remain unanswered. For example, no one has accurately estimated how much garbage enters the ocean each year—much less the volume of plastic that's swirling around in the water at any time. And despite the oft-repeated claim that the Great Pacific Garbage Patch is "twice the size of Texas," we don't really know the exact size of the Patch or how much garbage it contains.

Nor do we fully understand the precise impacts of ocean trash. It's possible that, when all is said and done, we'll decide it's better to leave the Patch alone, rather than bringing all those bits and pieces back on land and dealing with a brand-new disposal headache. (Particularly when you consider all the emissions associated with fueling collection vessels.) Scientists do know that the marine debris can entangle or otherwise harm sea life: For example, animals may eat the garbage, which can not only lacerate their throats and stomachs but can also make them feel so full that they stop eating actual food. But it's hard to say with certainty exactly how many animals are killed this way. Some of the garbage patches in the

Pacific have more teeming ecosystems than others—the dragonfly-shaped area on this map, for example, has high amounts of fish, phytoplankton and zooplankton, whereas the Garbage Patch itself (the pink area between California and Hawaii) is a relative dead zone, biologically. However, no matter where debris resides, it can pose a threat to wide-foraging seabirds like the albatross. And, because garbage patches move, they can also sweep trash onto land, endangering shore animals like seals.

There are even more questions about the risks posed by those tiny bits of plastic. It's well-established that plastic can absorb certain toxic pollutants, like PCBs and DDT, and that those pollutants—if absorbed into an animal's fat tissues—can work their way up the food chain. But according to Miriam Goldstein, a doctoral student who served as principal investigator on a recent expedition to the Garbage Patch, we can't yet draw any firm conclusions about the plastic's effects on human health. For example, while we do know that some fish species are eating these specks of plastic, we don't know whether they're doing so in significant numbers. We also don't know whether ingesting bits of polluted plastic is enough to transfer those toxins from the plastic into the fish's fatty tissues. (For that matter, there's already plenty of PCBs and DDT in the water itself, so even if we could remove all the plastic from the ocean, we wouldn't necessarily be fixing the toxic fish problem.)

None of this is to say that plastic in the oceans shouldn't be an area of concern. But unless the flow of garbage is stanched at the source, cleanup can only ever be a temporary solution.

Is there an environmental quandary that's been keeping you up at night? Send it to ask.the.lantern@gmail.com, and check this space every Tuesday.

Nina Shen Rastogi is a writer and editor in Brooklyn, N.Y.

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No Brakes!

Risk and the adolescent brain.

By Alan E. Kazdin and Carlo Rotella
POSTED THURSDAY, FEB. 4, 2010, AT 10:02 AM ET

It's often said that adolescents are fearless and see themselves as invulnerable, that they're irrational in how they reason and process information, that they act with no logical basis for their decisions and don't really understand risk. This is all a little true, but only to the extent that it's true of everybody. People of all ages are bad at assessing risk and making rational decisions. People of all ages underestimate likely dangers and overestimate unlikely ones.

That's why Americans—who insist on their right to drive, use the phone, and eat at the same time—are more afraid of being killed by dastardly foreigners than by their neighbors or themselves. A series of recent studies has demonstrated that the level of irrationality among adolescents and adults is about the same, which means that we can no longer explain the risky behavior of teenagers by telling ourselves that adolescents suffer from some special inability to reason.

These studies also encourage us to reconsider the notion that adolescents just make uniquely bad choices, and the corollary assumption that if we just *tell* them how to make better choices they will do so.

There are powerful forces—such as the brain's reaction to the presence of peers as a potent prompt and reward for sensation-seeking—that can move an adolescent to select risky behavior as the "right" choice. Urging kids to "Just Say No" to drugs, for instance, has been ineffective because it misses key factors leading to drug use. A given young person might say "No" when he or she is alone, but not when surrounded by peers. In fact, opting to say "Yes!" to drugs at a party—in a situation replete with the novel sensation and peer influence that light up the early adolescent brain like a Christmas tree—makes perfect sense because it maximizes rewards.

Interventions based on these erroneous assumptions are not likely to help much.

They include:

1. Reasoning with your child

We've written before about the relative ineffectiveness of reasoned argument as a way to change behavior. That's especially true in this case. When you sit down to explain to your early adolescent why it's unwise to climb the town water tower to have sex with predicate felons while doing nitrous, you're acting on two assumptions that we now know to be false: 1) teenagers do not understand risk and consequences (which leads to the mistaken notion that you can change your child's behavior by patiently explaining the dangers of the water tower escapade), and 2) the system in the early-adolescent brain that controls reason and abstract thinking can control the risky behavior encouraged by the system keyed to social and emotional stimulus. (More on these two systems later.)

Yes, it's always good to explain things to one's children, and doing so in a consistent, reasonable, gentle, and loving way can help build a strong relationship, which helps. And your explanation may well give them a tool for reasoning that they can reach for when they are ready to use what's in their mental toolbox. But your child may not be ready now. The potential positive long-term effects of explanation do not make it an effective short-term intervention that will stop your early-adolescent child from going out and doing something risky tomorrow.

2. Educational programs in the schools

This is a more expensive, elaborate, and systematic version of No. 1. Our schools make available all sorts of programs to explain to students what the problem is (drinking is bad), what it does (alters judgment), what can happen (car accident and death), and what one should do (don't drink). More than 90 percent of all U.S. high-school students have been exposed to sex, drug, and driver education in their schools, yet they still engage in high-risk behaviors. Current research now suggests that attempts to make adolescents less impulsive, less shortsighted, and more aware of consequences have very weak effects, if any, on behavior. That doesn't mean the programs are worthless. Some tiny number of students will be influenced by them in the short run, and in the long run they're likely to provide tools that a maturing young person can take up when the further development of the cognitive-control system has brought him to the point that he's ready to use them.

3. Pledges not to engage in risky behavior

One common intervention especially beloved by moral crusaders and supported by government funds asks teenagers to formally promise not to engage in behaviors that place them at risk. The focus has been on sexual activity. As far as we can tell, it doesn't work, and occasionally it makes things worse. A recent study by Janet Rosenbaum of Johns Hopkins University evaluated the effect of pledging abstinence (the "virginity pledge") versus not pledging among teenagers and then followed them for five years to evaluate the impact on sexual activity. Five years after the pledge, the results indicated that pledgers and nonpledgers did not differ in amount of premarital sex, sexually transmitted diseases, anal or oral sex, age of first sex, or number of sexual partners. Pledgers had used birth control and condoms *less* often than nonpledgers in the past year or at last sex. In short, the intervention was effective only in *decreasing* precautions taken during sex. As an ancillary but not irrelevant finding, five years after taking the virginity pledge 82 percent of the pledgers denied having ever pledged.

In our next piece we'll turn to what does seem to work best in containing adolescent risk, but first we need to take a closer look at the science. It's probably not a big surprise that those who take the most risks in adolescence tend to experience relatively poor long-term outcomes: higher rates of dropout, job loss, divorce, criminal behavior, dissatisfaction in relationships. But so do those who take no risks at all. Those in the middle of the sample, the vast majority who during adolescence take more risks than before but don't go completely wild, seem to do better over the long haul.

Whether that's because too little adolescent risk is as damaging to future development as too much or because the tendency to take too much or too little risk reflects personality characteristics already in place when puberty hits, the pattern of outcomes suggests that the human animal appears to be designed to function normally when its behavior grows somewhat riskier at the beginning of adolescence. The top 10 in terms of danger—regular alcohol use, regular binge drinking, tobacco use, marijuana use, other illegal drug use, fighting, carrying a weapon, suicidal thoughts, suicide attempts, unprotected sexual behavior—qualify for that honor not only in their own right but because they are associated with other dangers, like car accidents, the leading cause of death among teenagers ages 15 to 19.

Speaking of car accidents, Larry Steinberg of Temple University, a leader in research on teenagers and risk, has described the early-adolescent brain as being like a car with a very responsive accelerator and weak brakes. Steinberg and others have put two brain systems under particular scrutiny in recent years.

The first, Steinberg's gas pedal, is the social-emotional system. About the time of the onset of puberty, changes in brain structure and function, hormones, and neurotransmitters work together to increase the desire to seek out rewarding experiences, especially the sensation afforded by novel and risky behavior. The effect of brain function is also conditioned by the social environment. Various lab experiments, including video driving games and gambling games, show that adolescents take more risks if peers are present or evaluating their performance.

Social information (*Are people my age around?*) connects with the brain's processing of rewards—in this case, neuroimaging shows that the presence of peers activates the same brain circuitry as does processing of rewarding experiences. Having peers around *is* a reward, and not having them around is felt as the

opposite, which begins to explain your 14-year-old's sullen, moody, heedless demeanor around the house. As the social-emotional system undergoes robust development in early adolescence, the brain gets better at guiding behavior toward sensation and reward—flooring it, in other words. But Steinberg's brakes don't kick in until a little later.

The brakes take the form of the cognitive-control system, which constitutes an individual's capacity for self-regulation, including inhibition, planning, weighing consequences and risks and rewards, and abstract thinking. This system develops later than the social-emotional system, a process continuing well into late adolescence and early adulthood. The cognitive-control system connects—literally—with parts of the brain that control emotions.

As the cognitive-control system begins to develop in middle and late adolescence, thought and emotion are better coordinated, and emotions are held more in check. An adolescent's sheer ability to reason may already match an adult's, but the development of this system allows that ability to exercise greater practical control over risky impulses. Also, the influence of peers and the interest in novel experiences grow less salient and are more easily restrained. Now that the teenager sees the cost of risk as higher and risky behaviors as not quite as rewarding as they used to be, he becomes more able to stop himself from flooring the gas pedal. The cognitive-control system's integration with the social-emotional system has been examined in studies that show how connections among areas of the brain proliferate to allow emotion and reason to "talk" to each other. One can see the effects of the second system's development not only in a reduction of risk behavior but also in adolescents' evaluations of reckless acts and increased caution.

The result is that risk-taking increases significantly with the onset of puberty, peaks somewhere in the middle of the decade between ages 10 and 20, and then declines and stabilizes in late adolescence and young adulthood. And, while in early adolescence antisocial and risky behavior is more likely to be done in groups, in late adolescence, such behaviors, to the extent they occur at all, are more likely to be performed by individuals acting alone. It makes sense, then, that age 16 is the peak year for deaths by car accident: The age at which most novice drivers can first get their licenses coincides with the tail end of the peak of sensation-seeking and risky behavior.

In one laboratory study, participants played a video driving game in which they had to decide whether to stop at a traffic light when it turned yellow. They were told that the longer they drove the more points they would earn but that they would lose all their points if they crashed into the wall that appeared across the intersection soon after the light turned yellow. The brief interval between the light's change to yellow and the wall's appearance varied, so it was risky to run the light, although those who took risks and survived them could drive longer. Loud music was playing in the background, and there was one more factor, a crucial one: The participants performed the task either alone or with two friends present.

When subjects were alone, levels of risky driving were comparable across the three age groups identified by the study's authors: adolescents (mean age 14), youths (mean age 20), and adults (mean age 34). The presence of friends had no effect on the adults' behavior, but it increased risk-taking by 50 percent among the youths and doubled risk-taking among the adolescents. Males took more risks than females, but the pattern of peers' effect depending on age was identical among males and females. The same basic dynamics also characterized the outcome of a gambling game and participants' answers to questions about their willingness to engage in antisocial behavior. Put a teenager in the company of peers, and he or she will become more comfortable with risk.

Alan E. Kazdin, who was president of the American Psychological Association in 2008, is John M. Musser professor of psychology and child psychiatry at Yale University and director of Yale's Parenting Center and Child Conduct Clinic.
Carlo Rotella is director of American studies at Boston College.

Article URL: http://www.slate.com/id/2243435/

Writers Helping Writers. Or Not. Cheever, Bradbury, Salinger and Vonnegut

In 2004, Nicola Nikolov, an émigré to the U.S. in 1976 from communist Bulgaria, walked into William Dailey Rare Books in Los Angeles with a small archive of letters.

Briefly recounting a dark biography past and reduced, if freer, circumstances present, he told of his life as a published Bulgarian author and his difficulty establishing a writing career for himself in the United States. It was extremely important to him that his writing be accepted.

In August of 1978, he wrote, heart in hand, two-page long, well-written, typed letters to a small number of American novelists, with full, dire biographical details, limning his struggles to get read by the New York publishing establishment, and sincerely requesting that the novelists read and evaluate a few stories that he had enclosed. He saved their responses.

John Cheever replied with a firm, self-effacing dodge. Returning a manuscript unread seemed "like abominable hypocrisy… [but] as an Academician, my reading schedule is crowded until next Spring and that…I consider my judgment on anything but my own work to be worthless."

Ray Bradbury bemoaned his lack of time but said he'd try to get around to reading them. "If, a month from now, I return them unread, you will understand, won't you? I am a complete loner, do everything myself, no secretary ever, do all my typing, letter-writing, revisions, which means my days are full, too full." Later, after offering pointed, practical advice on developing "friendships CLOSE AT HAND, to encourage you," he suggested that Nikola submit his work to an agent of Bradbury's acquaintance, with Bradbury's blessing. "I hope I will not fail you, but, if I do, it will not be because I am a [publishing] bureaucrat but an overworked and semi-mad author."

J.D. Salinger did not deign to write a separate reply. At the top-right of Nikolov's letter Salinger typed an ink-initialed rebuff stating his long-held conviction that "a writer makes a grave and often grievously consequential error in judgment if he so much as glances at another writer's unpublished manuscript, let alone agrees to read and pass some sort of esthetic judgment on it...," etc. He did not respond to Nikola's report that *Catcher in the Rye* was popular in Bulgaria and the U.S.S.R.

The 1978 writers' best friend/humanitarian prize is awarded to Kurt Vonnegut.

In an extraordinary, lengthy typed letter Vonnegut discussed the plight of the immigrant to the U.S. ("I would never urge anyone to come here, unless he were a world figure or multi-millionaire like Sozhenitzen") and the fiction writer in contemporary America: "the best books earn nothing, usually. There are supposedly, at any given time, no more than 300 people in this whole country who make their livings as self-employed writers.

America has more admirals on active duty than that." Then, miraculously, Vonnegut agreed to read the proffered short stories. Further, in an act of profound kindness, Vonnegut enclosed an unsolicited check for the poverty-stricken Bulgarian with the "hope that you and your wife will spend it on a good supper and a bottle of wine. The America you find yourselves in is the America I have tried to describe in my books. It makes no sense. Nobody knows what it is. Anything can happen. Cheers, Kurt Vonnegut."

Nikola Nikolov never did get published in the U.S.

So it goes...

http://www.bookpatrol.net/2010/02/writers-helping-writers-or-not-cheever.html

The writing on the cave wall

- 17 February 2010 by **Kate Ravilious**

Magazine issue 2748.

Time to look around the paintings (Image: Dozier Marc/Photolibrary)

THE first intrepid explorers to brave the 7-metre crawl through a perilously narrow tunnel leading to the Chauvet caves in southern France were rewarded with magnificent artwork to rival any modern composition. Stretching a full 3 metres in height, the paintings depict a troupe of majestic horses in deep colours, above a pair of boisterous rhinos in the midst of a fight. To the left, they found the beautiful rendering of a herd of prehistoric cows. "The horse heads just seem to leap out of the wall towards you," says Jean Clottes, former director of scientific research at the caves and one of the few people to see the paintings with his own eyes.

When faced with such spectacular beauty, who could blame the visiting anthropologists for largely ignoring the modest semicircles, lines and zigzags also marked on the walls? Yet dismissing them has proved to be something of a mistake. The latest research has shown that, far from being doodles, the marks are in fact highly symbolic, forming a written "code" that was familiar to all of the prehistoric tribes around France and possibly beyond. Indeed, these unprepossessing shapes may be just as remarkable as the paintings of trotting horses and tussling rhinos, providing a snapshot into humankind's first steps towards symbolism and writing.

Until now, the accepted view has been that our ancestors underwent a "creative explosion" around 30,000 to 40,000 years ago, when they suddenly began to think abstractly and create rock art. This idea is supported by the plethora of stunning cave paintings, like those at Chauvet, which started to proliferate across Europe around this time. Writing, on the other hand, appeared to come much later, with the earliest records of a pictographic writing system dating back to just 5000 years ago.

Few researchers, though, had given any serious thought to the relatively small and inconspicuous marks around the cave paintings. The evidence of humanity's early creativity, they thought, was clearly in the elaborate drawings.

While some scholars like Clottes had recorded the presence of cave signs at individual sites, Genevieve von Petzinger, then a student at the University of Victoria in British Columbia, Canada, was surprised to find that no one had brought all these records together to compare signs from different caves. And so, under the supervision of April Nowell, also at the University of Victoria, she devised an ambitious

masters project. She compiled a comprehensive database of all recorded cave signs from 146 sites in France, covering 25,000 years of prehistory from 35,000 to 10,000 years ago.

What emerged was startling: 26 signs, all drawn in the same style, appeared again and again at numerous sites (see illustration). Admittedly, some of the symbols are pretty basic, like straight lines, circles and triangles, but the fact that many of the more complex designs also appeared in several places hinted to von Petzinger and Nowell that they were meaningful - perhaps even the seeds of written communication.

What emerged was startling - 26 signs, all drawn in the same style, appeared again and again

A closer look confirmed their suspicions. When von Petzinger went back to some of the records of the cave walls, she noticed other, less abstract signs that appeared to represent a single part of a larger figure - like the tusks of a mammoth without an accompanying body. This feature, known as synecdoche, is common in the known pictographic languages. To von Petzinger and Nowell, it demonstrated that our ancestors were indeed considering how to represent ideas symbolically rather than realistically, eventually leading to the abstract symbols that were the basis of the original study.

"It was a way of communicating information in a concise way," says Nowell. "For example, the mammoth tusks may have simply represented a mammoth, or a mammoth hunt, or something that has nothing to do with a literal interpretation of mammoths." Other common forms of synecdoche include two concentric circles or triangles (used as eyes in horse and bison paintings), ibex horns and the hump of a mammoth. The claviform figure - which looks somewhat like a numeral 1 - may even be a stylised form of the female figure, she says.

The real clincher came with the observation that certain signs appear repeatedly in pairs. Negative hands and dots tend to be one of the most frequent pairings, for example, especially during a warm climate period known as the Gravettian (28,000 to 22,000 years ago). One site called Les Trois-Frères in the French Pyrenees, even shows four sign types grouped together: negative hands, dots, finger fluting and thumb stencils (a rare subcategory of the negative hands).

Grouping is typically seen in early pictographic languages - the combined symbols representing a new concept - and the researchers suspect that prehistoric Europeans had established a similar system. "The consistency of the pairings indicate that they could really have had a meaning," says Nowell. "We are perhaps seeing the first glimpses of a rudimentary language system."

Lines, dots and love hearts

Von Petzinger caused quite a stir when she presented her preliminary findings last April at the Paleoanthropology Society Meeting in Chicago. She and Nowell have recently submitted a paper to the journal *Antiquity* and they are currently preparing another paper for the *Journal of Human Evolution.* The Smithsonian Institution's National Museum of Natural History in Washington DC plans to include the symbols in a forthcoming exhibition on human evolution.

"This work is really exciting," says Iain Davidson, an Australian rock art specialist at the University of New England in New South Wales. "We can see that these people had a similar convention for representing something."

Suspecting that this was just the beginning of what the symbols could tell us about prehistoric culture, von Petzinger and Nowell's next move was to track where and when they emerged. The line turned out to be the most popular, being present at 70 per cent of the sites and appearing across all time periods, from 30,000 to 10,000 years ago.

The next most prolific signs were the open angle symbol and the dots, both appearing at 42 per cent of the sites throughout this period. The vast majority of the remaining symbols are each present in around one-

fifth of the French caves, the exceptions being the cordiform (roughly a love-heart shape), reniform (kidney shape), scalariform (ladder shape) and spiral, which all turned up in just a handful of sites. "The spiral only appears in two out of the 146 sites throughout the entire time period, which really surprised me as it is a common motif in many later cultures," says von Petzinger.

The Rhone valley and the Dordogne and Lot regions in the south seem to have been the original sites for the symbols in France: most signs seem to appear in these regions before spreading across the rest of the country. Notable exceptions include the zigzag, which first appeared in Provence and is a relative latecomer, debuting around 20,000 years ago.

No signs ever emerged in northern France, though. "For large periods of time the north was uninhabitable because of ice sheets coming and going, so there was less opportunity for culture to develop independently up there," says von Petzinger.

The Ice Age may have hindered the cultural revolution in the north, but elsewhere it could have been instrumental in furthering it. "People were forced to move south and congregate in 'refugia' during the last glacial maximum, 18,000 to 21,000 years ago, and it is at this time when we start to see an explosion in rock art," says Nowell. "One possibility is that they were using the signs to demarcate their territories."

Yet while long winters spent in caves might have induced people to spend time painting wonder walls, there are reasons to think the symbols originated much earlier on. One of the most intriguing facts to emerge from von Petzinger's work is that more than three-quarters of the symbols were present in the very earliest sites, from over 30,000 years ago.

"I was really surprised to discover this," says von Petzinger. If the creative explosion occurred 30,000 to 40,000 years ago, she would have expected to see evidence of symbols being invented and discarded at this early stage, with a long period of time passing before a recognisable system emerged. Instead, it appears that by 30,000 years ago a set of symbols was already well established.

Rewriting prehistory

That suggests we might need to rethink our ideas about prehistoric people, von Petzinger says. "This incredible diversity and continuity of use suggests that the symbolic revolution may have occurred before the arrival of the first modern humans in Europe." If she is right, it would push back the date of the creative explosion by tens of thousands of years.

The idea would seem to fit with a few tantalising finds that have emerged from Africa and the Middle East over recent years. At Blombos cave on South Africa's southern Cape, for example, archaeologists have recently discovered pieces of haematite (an iron oxide used to make red pigment) engraved with abstract designs that are at least 75,000 years old (*Science*, vol 323, p 569). Meanwhile, at the Skhul rock shelter in Israel, there are shell beads considered by some to be personal ornaments and evidence for symbolic behaviour as far back as 100,000 years ago (*Science*, vol 312, p 1785).

Further evidence may well come from caves elsewhere in the world, and indeed a tentative look at the existing records suggests that many of von Petzinger's symbols crop up in other places (see map). The open angle symbol, for example, can be seen on the engravings at Blombos cave.

Does this suggest that these symbols travelled with prehistoric tribes as they migrated from Africa? Von Petzinger and Nowell think so. Davidson, on the other hand, who has identified 18 of these symbols in Australia, is unconvinced that they have a common origin, maintaining that the creative explosion occurred independently in different parts of the globe around 40,000 years ago. Instead, he thinks the symbols reveal something about a change in the way people thought and viewed their world, which may have emerged around this time. "I believe that there was a cognitive change, which suddenly put art into people's heads," he says.

Clottes, however, thinks they could be on to something. "Language and abstract thought were probably practised long before 35,000 years ago, since 'modern humans' are some 200,000 years old. We shouldn't be surprised by the sophistication of these people's thinking: they were our great-great-grandparents after all," he says.

But if people really did have a symbolic culture this far back, why don't we find more evidence pre-dating 40,000 years ago? "Perhaps the earlier symbols tended to be carved into perishable things such as wood and skins, which have now disintegrated," says von Petzinger. And even if they did paint in caves many of the rock surfaces will have eroded away by now.

Whenever these symbols did emerge, the acceptance of symbolic representation would have been a turning point for these cultures. For one thing, it would have been the first time they could permanently store information. "Symbols enabled people to share information beyond an individual lifespan. It was a watershed moment," says Nowell.

One huge question remains, of course: what did the symbols actually mean? With no Rosetta Stone to act as a key for translation, the best we can do is guess at their purpose. Clottes has a hunch that they were much more than everyday jottings, and could have had spiritual significance. "They may have been a way of relating to supernatural forces. Perhaps they had special symbols for special ceremonies, or they may have been associated with the telling of special myths," he says.

One intriguing aspect is their possible use in deception. "Once symbolic utterances are recognised, communication becomes more flexible," says Davidson. "One result is that ambiguity can be introduced for concealing truths."

With no key to interpret these symbols, though, we can't know whether ancient humans were giving false directions to rival tribes or simply bragging about their hunting prowess. Our ancestor's secrets remain safe - at least for now.

Doodler or da Vinci?

When our ancestors painted beautiful works of art, were they intending them to be viewed by others, or did they just paint for their own pleasure?

The Lascaux caves, in the Dordogne region of France, may have the answer. There you can see a painting of a red cow with a black head high on one of the walls. Up close the cow appears to be stretched from head to toe, but when viewed from the ground the cow regains normal proportions. This technique, known as anamorphosis, is highly advanced, and suggests the painter was considering his audience as he painted the cow.

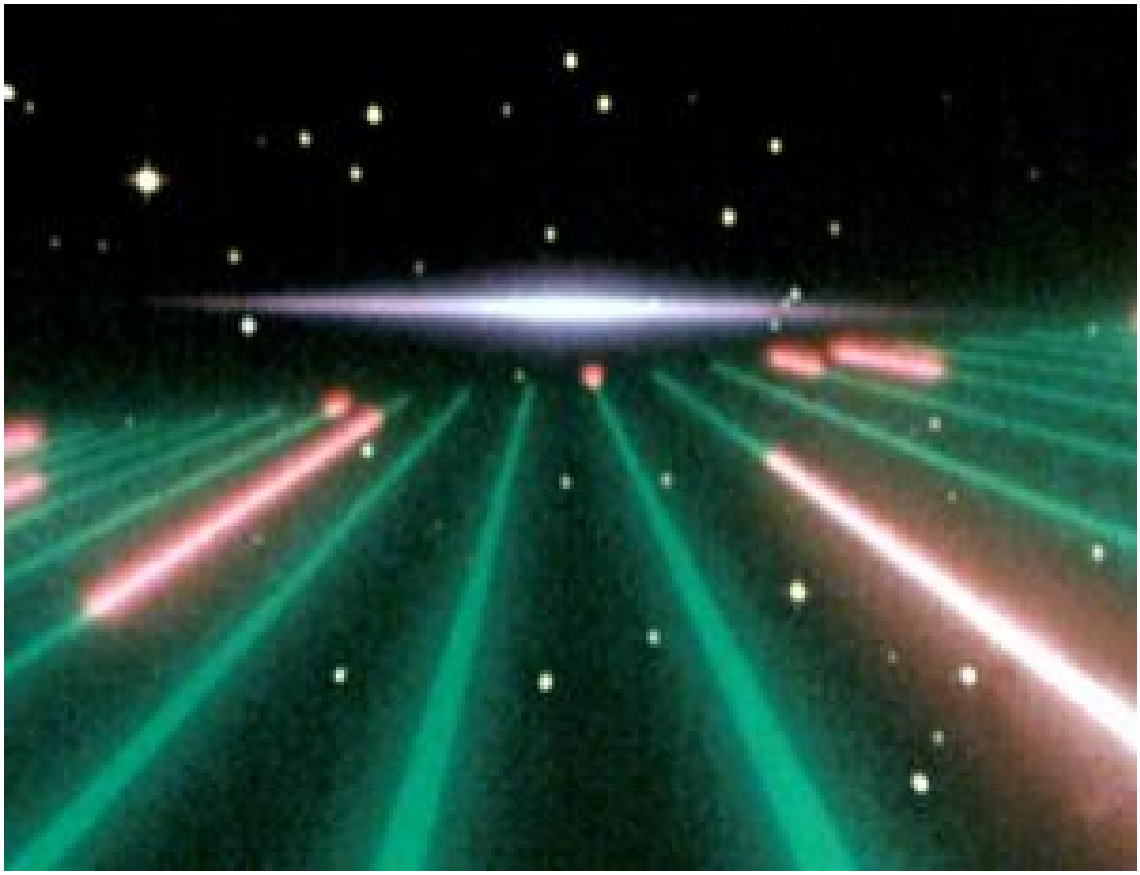
Our ancestors probably took the quality of their work very seriously. Recent work by Suzanne Villeneuve, from the University of Victoria in British Columbia, Canada, shows that the images painted with the most skill tend to occur in places where large numbers of people would have been able to see them, while poorer-quality images were more likely to be in smaller cubby holes. In most cases it seems that only the "Leonardos" of the day were allowed to paint the big spaces.

Kate Ravilious is a journalist based in York, UK

http://www.newscientist.com/article/mg20527481.200-the-writing-on-the-cave-wall.html?DCMP=NLC-nletter&nsref=mg20527481.200

Starship pilots: speed kills, especially warp speed

- Updated 18:02 17 February 2010 by **Valerie Jamieson**, Washington DC



This kind of speed could be fatal for the crew of the Enterprise (Image: Paramount/Everett/Rex Features)

Update: *An earlier version of this story referred to the Borg using cloaking technology, which several readers pointed out is not supported by televisual evidence. Of course, we were speculating on the technology existing in the alternate universe created by J. J. Abrams. However, to avoid confusion we have amended the decloaking reference to cite the Romulans.*

Star Trek fans, prepare to be disappointed. Kirk, Spock and the rest of the crew would die within a second of the USS Enterprise approaching the speed of light.

The problem lies with Einstein's special theory of relativity. It transforms the thin wisp of hydrogen gas that permeates interstellar space into an intense radiation beam that would kill humans within seconds and destroy the spacecraft's electronic instruments.

Interstellar space is an empty place. For every cubic centimetre, there are fewer than two hydrogen atoms, on average, compared with 30 billion billion atoms of air here on Earth. But according to William Edelstein of the Johns Hopkins University School of Medicine in Baltimore, Maryland, that sparse interstellar gas should worry the crew of a spaceship travelling close to the speed of light even more than Romulans decloaking off the starboard bow.

Special relativity describes how space and time are distorted for observers travelling at different speeds. For the crew of a spacecraft ramping up to light speed, interstellar space would appear highly compressed, thereby increasing the number of hydrogen atoms hitting the craft.

Death ray

Worse is that the atoms' kinetic energy also increases. For a crew to make the 50,000-light-year journey to the centre of the Milky Way within 10 years, they would have to travel at 99.999998 per cent the speed of light. At these speeds, hydrogen atoms would seem to reach a staggering 7 teraelectron volts – the same energy that protons will eventually reach in the Large Hadron Collider when it runs at full throttle. "For the crew, it would be like standing in front of the LHC beam," says Edelstein.

The spacecraft's hull would provide little protection. Edelstein calculates that a 10-centimetre-thick layer of aluminium would absorb less than 1 per cent of the energy. Because hydrogen atoms have a proton for a nucleus, this leaves the crew exposed to dangerous ionising radiation that breaks chemical bonds and damages DNA. "Hydrogen atoms are unavoidable space mines," says Edelstein.

The fatal dose of radiation for a human is 6 sieverts. Edelstein's calculations show that the crew would receive a radiation dose of more than 10,000 sieverts within a second. Intense radiation would also weaken the structure of the spacecraft and damage its electronic instruments.

Edelstein speculates this might be one reason why extraterrestrial civilisations haven't paid us a visit. Even if ET has mastered building a rocket that can travel at the speed of light, he may be lying dead inside a weakened craft whose navigation systems have short-circuited.

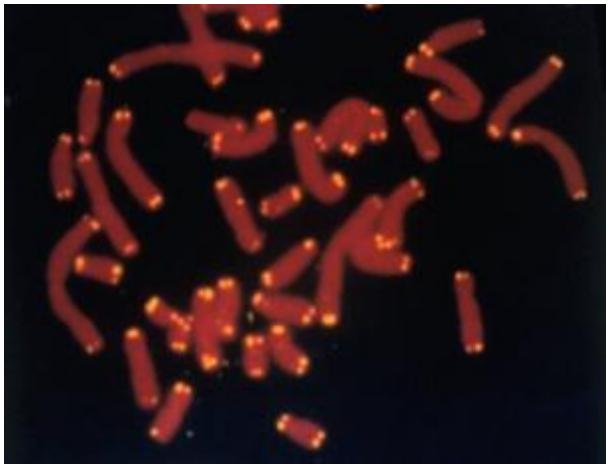
Edelstein presented his results on Saturday at the American Physical Society meeting in Washington DC.

http://www.newscientist.com/article/dn18532-starship-pilots-speed-kills-especially-warp-speed.html?DCMP=NLC-nletter&nsref=dn18532

Chromosome caps presage the brain's decline

- 12 February 2010 by **Anil Ananthaswamy**

Magazine issue 2747.



Tell-tale sign (Image: Time & Life Pictures/Getty Images)

A SIGN of a cell's age could help predict the onset of dementia. Elderly people are more likely to develop cognitive problems if their telomeres - the stretches of DNA that cap the ends of chromosomes - are shorter than those of their peers.

The shortening of telomeres is linked to reduced lifespan, heart disease and osteoarthritis. Telomeres naturally shorten with age as cells divide, but also contract when cells experience oxidative damage linked to metabolism. Such damage is associated with cognitive problems like dementia. Thomas von Zglinicki at Newcastle University, UK, showed in 2000 that people with dementia not caused by Alzheimer's tended to have shorter telomeres than people without dementia.

To see if healthy individuals with short telomeres are at risk of developing dementia, Kristine Yaffe at the University of California, San Francisco, and colleagues, followed 2734 physically fit adults with an average age of 74.

Yaffe's team tracked them for seven years and periodically assessed memory, language, concentration, attention, motor and other skills. At the start, the researchers measured the length of telomeres in blood cells and grouped each person according to short, medium or long telomeres.

After accounting for differences in age, race, sex and education, the researchers found that those with long telomeres experienced less cognitive decline compared to those with short or medium-length telomeres (*Neurobiology of Aging*, DOI: 10.1016/j.neurobiolaging.2009.12.006).

Von Zglinicki calls the work a "carefully done, large study", but notes that short telomeres by themselves are not enough to predict whether an individual will get dementia.The key, says Ian Deary at the University of Edinburgh, UK, will be to combine telomere length with other biomarkers. "Most likely, longer telomere length will become one ingredient in a recipe for successful mental and bodily ageing."

Longer telomere length will become one ingredient in a recipe for successful mental and bodily ageing

http://www.newscientist.com/article/mg20527473.700-chromosome-caps-presage-the-brains-decline.html

Act early in life to close health gaps across society

- 11 February 2010 by **Andy Coghlan**
- Magazine issue 2747.

Giving a child the best start in life (Image: Keiji Iwai/Getty)

THAT a lack of wealth all too often translates into poor health may seem painfully obvious. But now a review of health inequalities in England reveals that such disparities don't just disadvantage the least well-off. The review also suggests some strategies to tackle the inequalities. These remedies should apply the world over, including in the US, where health and wealth inequalities can be especially stark.

Commissioned by the UK government, the review was headed by Michael Marmot of University College London, who most famously showed that British civil servants at the bottom of the organisational pile were much more likely to suffer coronary heart disease than those at the very top. In his latest work, Marmot uses census data from across England to show that these health inequalities don't just exist between the richest and the poorest.

For example, even if you exclude the richest and poorest 5 per cent of people in England, the richest remainder can expect to live 6 years longer than the poorest, and enjoy an extra 13 years free of disability. Marmot says action to reduce health inequalities should take place right across society, not focus solely on the poor. "It's not rich versus poor, because it's a social gradient," he says.

What's more, the most productive time to intervene to create a healthier society is childhood, Marmot says. That children who start out with well-off, well-educated parents are likely to be healthier would seem to be something of a no-brainer. But the fates of 17,200 UK babies monitored since they were born in the same week in April 1970, and highlighted in Marmot's review, make compelling evidence.

It turns out that babies who had low IQs at 22 months and were born to richer, better educated parents caught up by the age of 6 with children who started with high IQs but whose parents were poorer and less educated. By age 10, the children in the higher socio-economic group were forging ahead on intelligence tests while those in the lower socio-economic group fell further and further behind (see diagram). "It shows that the social is trumping the biological," says Marmot. "We can change that, and that's why I'm optimistic."

He also finds that children in poorer families miss out on pre-school reading, socialising and physical exercise (see diagram). This disadvantage leaves them trailing far behind when they start school (see diagram) and they seldom recover (see diagram).

Diagrams: Being behind can lead to behavioural and emotional problems. What's more, the UK spends less on children during early childhood than at any other stage of their education

Such inequalities are not confined to the UK. A report in April 2009 by the US-based Robert Wood Johnson Foundation concluded that interventions most likely to improve the health of all Americans were "programs that promote early childhood development and that support children and families". A report from Brazil recommended prioritising "actions related to health promotion of children and adolescents".

"We look forward to assessing how to adapt the policy recommendations for England to the rest of the world," says Rüdiger Krech, director of the WHO's department of ethics, equity, trade and human rights. He agrees that giving every child the best start in life "is critical in setting the foundation for a lifetime of health and successful contribution to society".

What can be done to ensure this? One option is to extend maternity or paternity leave, suggests Marmot. Another is to help struggling parents by providing extra services and information.

http://www.newscientist.com/article/mg20527473.800-act-early-in-life-to-close-health-gaps-across-society.html

Child psychiatric diagnosis on trial

- 18:11 16 February 2010 by **Peter Aldhous**

Carolyn Riley overdosed her daughter on psychotropic drugs (Image: Gary Higgins/AP/PA)

When Carolyn Riley was convicted of killing her 4-year-old daughter Rebecca by overdosing her with psychotropic drugs prescribed for the child, some jurors reportedly felt that the psychiatrist who wrote the prescriptions should also have been on trial.

That will not happen: the doctor was granted immunity when agreeing to testify in the case. But the validity of the condition for which Rebecca was being treated is being questioned by psychiatrists. The American Psychiatric Association (APA) says it needs to be replaced by an entirely new diagnosis, while others argue that this move could create fresh problems.

Rebecca was being treated for juvenile bipolar disorder. The number of children diagnosed with this condition has skyrocketed: in 2003 it was diagnosed in 1 in 100 under-20s who visited US doctors, up from 1 in 4000 in 1995, according to one estimate.

But the day after Carolyn Riley's conviction for second-degree murder last week, the APA released proposals suggesting that a newly defined condition, to be called temper dysregulation disorder with dysphoria(TDD), would better reflect the problems of many children who swing between extreme outbursts of aggression and periods of irritability, anger and sadness, and who are now classed as bipolar.

According to Gabrielle Carlson, a child psychiatrist at Stony Brook University in New York, diagnoses of juvenile bipolar disorder rose partly as a knock-on from previous diagnostic shifts, including a narrowing of "conduct disorder" to focus on children who will go on to develop antisocial personality disorder.

That left psychiatrists searching for a label to guide treatment for children who were prone to severe violent outbursts and persistent mood problems. The answer seemed to come in 1995, when Janet Wozniak of Massachusetts General Hospital in Boston argued that the violent outbursts were equivalent

to the manic episodes of adults with bipolar disorder. It has since emerged, however, that these children rarely go on to become bipolar adults.

The big question is what effect a new diagnosis will have on treatment. Rebecca Riley was on an antipsychotic called quetiapine, the anticonvulsant valproate, and clonidine, which was being given as a sedative. The most severe cases of TDD might still be treated with antipsychotics, but probably only as a temporary measure. With bipolar disorder, drugs are often prescribed long-term.

The psychiatrist Allen Frances, who led a 1994 revision of the APA's diagnostic manual, has already accused the association of creating a "new monster". Writing in the professional newspaper Psychiatric Times, Frances argued that TDD "would be very common at every age in the general population and would promote a large expansion in the use of antipsychotic medications".

That criticism is rejected by David Shaffer of Columbia University in New York, who chairs the APA working group that proposed the new TDD definition. He argues that it has been carefully defined to focus on children with especially severe outbursts. "It's not psychiatrising normal temper tantrums," he says.

http://www.newscientist.com/article/dn18534-child-psychiatric-diagnosis-on-trial.html

Superbugs blamed on shoddy repairs

- 17:31 16 February 2010 by **Debora MacKenzie**

Bacteria that survive an antibiotic attack emerge stronger, with an ability to repel new drugs – but why?

The conventional idea is that susceptible bugs perish, leaving behind a few individuals whose drug resistance is passed on as they multiply. This does not, however, explain why bacteria treated with one drug tend to resist others too.

Now Jim Collins at Boston University and his team have found that several different kinds of antibiotics can actively create mutations that confer this multidrug resistance.

The antibiotics produce toxic molecules called free radicals that damage the DNA of *Escherichia coli*, and the resulting mutations are locked in when a sloppy repair system fails to put the DNA back together properly. "What doesn't kill them makes them stronger," says Collins. He hopes that blocking DNA repair will slow the emergence of multidrug-resistant superbugs .

Morten Sommer a microbiologist Harvard Medical School in Boston, calls the discovery "very important". Levels of antibiotics vary throughout the body during treatment, but they are most likely to create new mutations where drug levels are low.

Journal reference: *Molecular Cell*, DOI: 10.1016/j.molcel.2010.01.003

http://www.newscientist.com/article/dn18533-superbugs-blamed-on-shoddy-repairs.html

Healing touch: the key to regenerating bodies

- 16 February 2010 by **Bob Holmes**
- Magazine issue 2747.

Get touchy-feely (Image: David Plunkert)

YOU started life as a single cell. Now you are made of many trillions. There are more cells in your body than there are stars in the galaxy. Every day billions of these cells are replaced. And if you hurt yourself, billions more cells spring up to repair broken blood vessels and make new skin, muscle or even bone.

Even more amazing than the staggering number of cells, though, is the fact that, by and large, they all know what to do - whether to become skin or bone and so on. The question is, how?

"Cells don't have eyes or ears," says Dennis Discher, a biophysical engineer at the University of Pennsylvania in Philadelphia. "If you were blind and deaf, you'd get around by touch and smell. You'd feel a soft chair to sit on, a hard wall to avoid, or whether you're walking on carpet or concrete."

Until recently, the focus was all on "smell": that is, on how cells respond to chemical signals such as growth factors. Biologists thought of cells as automatons that blindly followed the orders they were given. In recent years, however, it has started to become clear that the sense of touch is vital as well, allowing cells to work out for themselves where they are and what they should be doing. Expose stem cells to flowing fluid, for instance, and they turn into blood vessels. Simply expose stem cells to flowing fluid and they turn into blood vessels What is emerging is a far more dynamic picture of growth and development, with a great deal of interplay between cells, genes and our body's internal environment. This may explain why exercise and physical therapy are so important to health and healing - if cells don't get the right physical cues when you are recovering from an injury, for instance, they won't know what to do. It also helps explain how organisms evolve new shapes - the better cells become at sensing what they should do, the fewer genetic instructions they need to be given.

The latest findings are also good news for people who need replacement tissues and organs. If tissue engineers can just provide the right physical environment, it should make it easier to transform stem cells into specific tissues and create complex, three-dimensional organs that are as good as the real thing. And doctors are already experimenting with ways of using tactile cues to improve wound healing and regeneration.

Biologists have long suspected that mechanical forces may help shape development. "A hundred years ago, people looked at embryos and saw that it was an incredibly physical process," says Donald Ingber,

head of Harvard University's Wyss Institute for Biologically Inspired Engineering. "Then when biochemistry and molecular biology came in, the baby was thrown out with the bath water and everybody just focused on chemicals and genes."

While it was clear that physical forces do play a role - for example, astronauts living in zero gravity suffer bone loss - until recently there was no way to measure and experiment with the tiny forces experienced by individual cells. Only in the past few years, as equipment like atomic force microscopes has become more common, have biologists, physicists and tissue engineers begun to get to grips with how forces shape cells' behaviour. One of the clearest examples comes from Discher and his colleagues, who used atomic force microscopy to measure the stiffness of a variety of tissues and gel pads. Then they grew human mesenchymal stem cells - the precursors of bone, muscle and many other tissue types - on the gels. In each case, the cells turned into the tissue that most closely matched the stiffness of the gel.

The softest gels, which were as flabby as brain tissue, gave rise to nerve cells. In contrast, gels that were 10 times stiffer - like muscle tissue - generated muscle cells, and yet stiffer gels gave rise to bone (*Cell*, vol 126, p 677). "What's surprising is not that there are tactile differences between one tissue and another," says Discher. After all, doctors rely on such differences every time they palpate your abdomen. "What's surprising is that cells feel that difference."

The details of how they do this are now emerging. Most cells other than blood cells live within a fibrous extracellular matrix. Each cell is linked to this matrix by proteins in its membrane called integrins, and the cell's internal protein skeleton is constantly tugging on these integrins to create a taut, tuned whole. "There's isometric tension that you don't see," says Ingber. In practice, this means changes in external tension - such as differences in the stiffness of the matrix, or the everyday stresses and strains of normal muscle movement - can be transmitted into the cell and ultimately to the nucleus, where they can direct the cell's eventual fate.

Since stem cells have yet to turn into specific cell types, biologists expected them to be extra sensitive to the environment, and this does indeed seem to be the case. Ning Wang, a bioengineer at the University of Illinois at Urbana-Champaign, found that the embryonic stem cells of mice are much softer than other, more specialised cells. This softness means that tiny external forces can deform the cells and influence their development (*Nature Materials*, vol 9, p 82).

For instance, if stem cells are exposed to flowing fluid, they turn into the endothelial cells that line the inner surface of blood vessels. In fact, fluid flow - particularly pulses that mimic the effect of a beating heart - is proving crucial for growing replacement arteries in the laboratory. The rhythmic stress helps align the fibres of the developing artery, making them twice as strong, says Laura Niklason, a tissue engineer at Yale University. A biotech company Niklason founded, called Humacyte, has begun animal testing on arteries grown this way. Surprisingly, pulsatile motion can help heal injuries in situ too. At Harvard, Ingber and his colleague Dennis Orgill are treating patients with difficult-to-heal wounds by implanting a small sponge in the wound and connecting this to a pump. The pump sucks the cells surrounding the wound in and out of the sponge's pores, distorting them by about 15 to 20 per cent - an almost ideal stimulus for inducing the cells to grow and form blood vessels and thus boost the healing process, says Ingber.

Meanwhile, tissue engineers are finding that they can grow far better bone and cartilage by mimicking the stresses that the tissues normally experience in the body. For instance, human cartilage grown in the lab is usually nowhere near as strong as the real thing. Recently, however, Clark Hung, a biomedical engineer at Columbia University in New York City, has grown cartilage that matches its natural counterpart strength for strength. The secret, he has found, is rhythmically squeezing the cartilage as it grows to mimic the stress of walking.

The secret of growing cartilage that is as strong as the real thing is to mimic the effects of walking

Hung says this is partly because the pressure helps to pump nutrients into cartilage, which has no blood vessels. But his experiments suggest that the loading alone also plays an important role. His team hopes the engineered cartilage will eventually be used to resurface arthritic human joints.

Even relatively mild stresses make a big difference. Attempts to grow replacement bone by placing stem cells in a culture chamber of the desired shape have not been very successful, with the cells often dying or producing only weak bone. But Gordana Vunjak-Novakovic, a biomedical engineer also at Columbia, has found that mimicking the internal flow of fluid that growing bones normally experience helps maximise strength. Last year, her team used this approach to successfully grow a replica of part of the temporomandibular joint in the jaw from human stem cells, producing a naturally shaped, fully viable bone after just five weeks.

"If you don't stimulate bone cells, they don't do much," says Vunjak-Novakovic. "But if you do, they wake up and start making bone at a higher rate."

There is still a long way to go, however. The replica bone lacks the thin layer of cartilage that lines the real bone, and it also lacks a blood supply, so it begins to starve as soon as it is removed from the culture chamber.

Again, though, the answer could be to provide the cells with the right physical cues. For example, Vunjak-Novakovic has used lasers to drill channels in the scaffolds used to grow heart muscle in the lab. When fluid begins flowing through these channels, endothelial cells move in to line the channels while muscle cells move away. "Each of the cells will find its own niche," she says. Her team is now testing to see whether stem cells will turn into endothelial cells in the channels and into muscle cells elsewhere. Early results suggest that they will.

Even small differences in forces can influence development. Christopher Chen of the University of Pennsylvania grew flat sheets of mesenchymal stem cells and exposed them to a mixture of growth factors for bone and marrow development. The cells on the edges of the sheets, which were exposed to the greatest stresses, turned into bone cells, while those in the middle turned into the fat cells found in marrow, as in real bone (*Stem Cells*, vol 26, p 2921).

If this kind of sorting-out according to physical forces is widespread in development, it could be very good news for tissue engineers. Instead of having to micromanage the process of producing a replacement organ, they need only to provide the right cues and let the cells do the rest.

If tissue engineers provide the right physical cues when growing organs, cells will do the rest

Indeed, it makes a lot of sense for some developmental decisions to be "devolved" to cells. The growth of tissues like muscles, bone, skin and blood vessels has to be coordinated as our bodies develop and adapt to different activities and injuries. A rigid genetic programme could easily be derailed, whereas using tactile cues as guides allows tissues to adapt quickly as conditions change - for instance, carrying heavy loads will make our bones grow stronger.

This kind of plasticity may play a vital role in evolution as well as during the lifetime of individuals. When the ancestors of giraffes acquired mutations that made their necks longer, for instance, they did not have to evolve a whole new blueprint for making necks. Instead, the nerves, muscles and skin would have grown proportionately without needing further changes in instructions. The result of this plasticity is a developmental programme that is better able to cope with evolutionary changes, says Ingber.

There is, however, a drawback. When disease or injury changes the stiffness of a tissue, things can go awry. Some researchers suspect that tissue stiffening plays a role in multiple sclerosis, in which nerves lose their protective myelin sheath (*Journal of Biology*, vol 8, p 78). It may also play a role in some cancers (see "Lumps and bumps").

It could also explain why many tissues fail to heal perfectly after an injury. To prevent infection, the body needs to patch up wounds as quickly as possible. So it uses a form of collagen that is easier to assemble than the normal one. "It's a quick patch, things are sealed off and you go on - but it's not perfect regeneration," says Discher. The quick-fix collagen is stiffer than normal tissue, as anyone with a large scar will tell you.

After a heart attack, for example, the dead portion of the heart muscle scars over. Why, Discher wondered, don't heart muscle cells then replace the scar tissue? To find out, he and his colleagues grew embryonic heart cells on matrixes of differing stiffness. When the matrix was the same stiffness as healthy heart muscle, the cells grew normally and beat happily. But if the matrix was as stiff as scar tissue, the cells gradually stopped beating (*Journal of Cell Science*, vol 121, p 3794).

The constant work of trying to flex the stiffer matrix wears the cells out, Discher thinks. "It's like pushing on a brick wall. Finally, they give up."

Discher believes the solution may lie in finding a way to soften the scar tissue so that heart cells can repopulate it. Several enzymes, such as matrix metalloproteinases and collagenases, might do the job, but overdoing it could be risky. "If you degrade the matrix too much, you lose the patch," he warns.

The stiffness of scar tissue may also prevent regeneration in nerve injury, because nerve cells prefer the softest of surroundings. "It might just be that the growing tip of the axon senses that there's a stiff wall ahead of it and doesn't grow through because of that," speculates Jochen Guck, a biophysicist at the University of Cambridge in the UK.

There is still a long way to go before we fully understand how cells sense and respond to the forces on them. But it is becoming clear that the touchy-feely approach could be the key to regenerating the body.

Lumps and bumps

Many tumours are stiffer than the tissues in which they form - after all, doctors often first detect many cancers of organs such as the breast and prostate by feeling a hard lump. Some researchers now suspect that this stiffness is not always just a consequence of the cancer. It may be a cause as well.

A team led by Paul Janmey, a biophysicist at the University of Pennsylvania in Philadelphia, has found that the cycle of cell division in breast cells stops when they are grown on a soft gel, keeping them in a quiescent state (*Current Biology*, vol 19, p 1511). Anything that signals stiffness - even just touching a cell with a rigid probe - can be enough to start it dividing again.

Similarly, when Valerie Weaver, a cancer biologist at the University of California at San Francisco, and her team used chemicals to soften the extracellular matrix in which breast cells were growing in the lab they found the cells were less likely to become malignant (*Cell*, vol 139, p 891). If her findings are confirmed, they could explain why women with denser breast tissue are more likely to develop breast cancer.

Some researchers, too, have reported seeing tumours form around the scars from breast-implant surgery. "This needs to be looked at again," says Weaver. If the link is confirmed, it might be possible to block tumour growth by interfering with the way cells detect stiffness.

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http://www.newscientist.com/article/mg20527471.100-healing-touch-the-key-to-regenerating-bodies.html

Anti-ageing cream as good as drug at reducing wrinkles

- 15:07 15 February 2010 by **Linda Geddes**

Proving the benefits (Image: Ebby May/Getty)

The cosmetics industry could be on the brink of a much-needed facelift. For the first time, an anti-wrinkle cosmetic has been compared with the gold-standard prescription drug for skin ageing – and appears to be just as effective at reducing wrinkle depth.

As well as being good news for people who want to look younger for longer, the result – from US-based researchers at the firm Procter & Gamble – could up the pressure on cosmetics companies to offer proof of the claims they make about their products. Until now, such proof has been thin on the ground.

"I think these studies will raise the bar, because they show that you can trial these products in the same way that you trial a drug, and the cosmetics industry has never had to do that before," says Christopher Griffiths of the University of Manchester, UK, who advised P&G on the design of the study, but was not involved in carrying it out.

To develop the cosmetic – which consists of a regimen of three creams sold as Olay Pro-x – P&G used DNA microarrays to screen a range of existing cosmetic ingredients and identify those that changed the expression of a number of genes involved in skin ageing.

What the experts want

Before testing the resulting product, the firm consulted a panel of eight dermatologists, including Griffiths, and asked them what evidence they would need to be convinced that it worked.

The panel's first suggestion was that the product be tested over a prolonged period of time, around eight weeks. "Then we said, 'You're also going to have to go up against the clinical benchmark: tretinoin [trans-retinoic-acid],'" says panel member Stephen Mandy, a practising dermatologist based in Florida and a volunteer professor at the University of Miami. "There was this kind of hushed silence. Then they agreed to do it."

P&G isn't the first cosmetics firm to make public a scientific trial of a skincare product. In 2007, Boots in the UK made headlines when it compared its "Protect and Perfect" lotion with retinoic acid in a 12-day trial and showed that there was less sun damage in biopsies of skin treated with Protect and Perfect.

But P&G's latest result is the first long-term trial that has shown a cosmetic product to be as effective as retinoic acid. A longer-term trial of Protect and Perfect also produced a positive result, but only in comparison with a placebo moisturiser, not retinoic acid.

Wrinkle depth

In the current study, 99 women volunteers were given a regimen of three Olay Pro-x products, and 97 were prescribed tretinoin. The depth of their wrinkles was assessed before and after the treatments, and those assessing them were not told which product the women were using.

After eight weeks, the women using Pro-x showed a significant improvement in the appearance of their wrinkles compared with those using tretinoin. The women also tolerated Pro-x better than tretinoin, which caused irritation in some of the women.

Some of the volunteers were followed for a further 16 weeks, after which both treatments were judged to have improved the appearance of wrinkles to about the same extent.

"This is the first time that a cosmetic product has been tested head-to-head against a drug product over a long period of time and they've shown parity," says Mandy. "This is pretty landmark stuff."

Medicine or make-up?

It's not only researchers who advised P&G that are impressed. "I'm delighted somebody has done a real study and that they're setting about this with a scientific method," says Richard Weller , a dermatologist at the University of Edinburgh, UK. "I'm hoping that the public will fall for hard data and base their decisions on that."

But if Olay Pro-x works as well as a drug, should it be classified as one? P&G don't have to worry about that in the US: there, it is already on sale, and its components have previously been classified as cosmetic ingredients, meaning that it can be marketed as a cosmetic product.

A similar argument may well hold in the UK. "As long as you're not talking about diseases, the product remains a cosmetic, unless you have in it an ingredient that is only available on prescription," says Chris Flower, director of the UK's Cosmetic, Toiletry and Perfumery Association.

But Weller says the new finding could prevent Olay Pro-x from being launched as a cosmetic in Europe. He says that the European Cosmetics Directive considers a product that has a significant effect to be more than just a cosmetic. "Here they are saying something is as good as retinoic acid, which is a prescription drug," he says.

Reference: *British Journal of Dermatology*, DOI: 10.1111/j.1365-2133.2009.09436.x

http://www.newscientist.com/article/dn18525-antiageing-cream-as-good-as-drug-at-reducing-wrinkles.html

A gene for Alzheimer's makes you smarter

- 15 February 2010 by **Ewen Callaway**

Magazine issue 2747.

An intellectual advantage (Image: Joerg Sarbach/AP/PA)

A GENE variant that ups your risk of developing Alzheimer's disease in old age may not be all bad. It seems that young people with the variant tend to be smarter, more educated and have better memories than their peers.

The discovery may improve the variant's negative image (see "Yes or no"). It also suggests why the variant is common despite its debilitating effects in old age. Carriers of the variant may have an advantage earlier in life, allowing them to reproduce and pass on the variant before its negative effects kick in. "From an evolutionary perspective it makes sense," says Duke Han at Rush University Medical Center in Chicago. The "allele" in question is epsilon 4, a version of the apolipoprotein E gene (*APOE*). Having one copy increases the risk of developing Alzheimer's at least fourfold compared with people who have other forms of the gene. A person with two copies has up to 20 times the risk.

One big clue that epsilon 4 might be beneficial emerged several years ago, when Han's team scanned the *APOE* genes of 78 American soldiers. All had suffered traumatic brain injuries, many while serving in Iraq. Sixteen had at least one copy of epsilon 4. Han's team expected to find that these carriers would be in worse cognitive shape than their counterparts with different versions of *APOE*, given previous studies that showed elderly people with epsilon 4 fare worse after head injury. But the opposite was true: soldiers with the epsilon 4 allele had better memory and attention spans (*Journal of Neurology, Neurosurgery & Psychiatry*, DOI: 10.1136/jnnp.2006.108183).

It wasn't the first study to suggest that epsilon 4 may be beneficial to the young. Back in 2000, researchers showed that young women with epsilon 4 have IQs a few points higher than those with no copies of the variant and score 7 points higher on the non-verbal portion of a common intelligence test (*Neuroscience Letters*, vol 294, p 179). Then in the Czech Republic in 2001, researchers showed that 87 per cent of epsilon 4 carriers go on to university, compared with 55 per cent of people with another version of *APOE*. The last group were also more likely to drop out of school (*Neuropsychobiology*, DOI: 10.1159/000054890).

More recently, Jenny Rusted of the University of Sussex, UK, and Natalie Marchant at the University of California, Berkeley, have uncovered still more benefits for young people carrying epsilon 4. Those aged between 18 and 30 with the gene variant excelled at tasks requiring the frontal lobe, a brain region

involved in higher cognitive skills. In particular, epsilon 4 carriers did better in a card game that asked them to remember a future plan while busy with another task (*Neuropsychopharmacology*, DOI: 10.1038/npp.2009.214).

Rusted suggests that epsilon 4 helps people focus on important information. But recalling something also requires you to tune out the irrelevant bits, an ability known to decline with age.

Perhaps, Rusted says, without this second capability, epsilon 4's benefits fall by the wayside. Why it has a negative effect in old age, however, is still a mystery, although a study carried out by Clare MacKay at the University of Oxford in 2009 offers a tentative, hypothesis.

Her team asked 20 to 35-year-olds to remember which pictures of animals or landscapes they had seen before, while having their brains scanned with functional MRI. It was an easy task and all performed equally well. But a brain region critical to memory lit up more strongly in epsilon 4 carriers than in the others, raising the intriguing possibility that carriers' brains get overworked in early life, only to be worn out by the time they hit old age. MacKay wouldn't go that far, but she says: "It's possible that your brain is having to work harder when it's younger and this may have consequences for later life."

Your brain may have to work harder when it's younger and this may have consequences later

Yes or No to knowing if you have epsilon 4?

When DNA co-discoverer James Watson published his genome in 2007, he left one tiny bit out: the piece that would have told him which version of the *APOE* gene he has. He opted not to know whether he was carrying the epsilon 4 version, which can vastly increase the odds of developing Alzheimer's disease.

He's not the only one to make an exception for *APOE:* Harvard University psychologist Steven Pinker, one of several high-profile scientists planning to make his genome freely available as part of the Personal Genome Project, will follow Watson's lead and keep his *APOE* sequence a mystery.

In contrast, genome pioneer Craig Venter has let the world know that he has one copy of epsilon 4, which also increases the odds of developing heart disease - and has started taking a cholesterol-lowering drug that he hopes may also delay Alzheimer's.

Scientific celebrities aren't the only ones who agonise over their *APOE* status. Anyone who has forked out a few hundred dollars to have their genome scanned can decide whether to find out if their *APOE* gene puts them at increased risk of Alzheimer's.

Knowing your status may not be all bad, says Robert Green of Boston University in Massachusetts, who over two years monitored how people reacted to finding out which version of the gene they have (*The New England Journal of Medicine*, vol 361, p 245). "By and large there were no catastrophic reactions," he says. The only people whose mood changed much were those relieved to discover they didn't have the risky variant.

If epsilon 4 does improve cognition in young adults (see main story) does that strengthen the case for knowing whether you carry that version?

Clare MacKay, who studies the effect of epsilon 4 on cognition at Oxford University, thinks not. "I wouldn't want to know whether I've got one and I certainly wouldn't want other people to know." Her lab is forbidden from telling the volunteers their *APOE* status. "It will only be a good idea to know your *APOE* genotype when there's something we can do about it," she says.

http://www.newscientist.com/article/mg20527474.000-a-gene-for-alzheimers-makes-you-smarter.html

Martian sheen: Life on the rocks

- 12 February 2010 by **Barry E. DiGregorio**

Magazine issue 2747.

Is desert varnish biological? (Image: Greg Willis/gregw66 under a CC 2.0 license)

6 more images

WHEN NASA's Viking landers touched down on Mars, they were looking for signs of life. Instead, all their cameras showed was a dry, dusty - and entirely barren - landscape.

Or so it seemed. But what the 1976 Viking mission, and every subsequent one, saw was a scene littered with rocks coated with a dark, highly reflective sheen. That coating looks a lot like a substance known on Earth as "rock varnish", found in arid regions similar to those on Mars. The latest evidence hints that rock varnish is formed by bacteria. Could there be microbes on Mars making such material too?

Rock varnish has long been something of a mystery. It is typically just 1 to 2 micrometres thick, but can take a thousand years or more to grow, making it very hard to discover whether biological or purely chemical processes are responsible. If it is biological, though, the race will be on to discover whether the same thing has happened on Mars - and whether microbes still live there today.

If you go to Death Valley in California, you can find rock varnish covering entire desert pavements. Also known as desert varnish, it forms in many places around the globe, and despite its glacial growth rates, can cover vast areas. The smooth, high sheen, dark brown-to-black coating is mainly made up of clay particles, which bind the iron and manganese oxides that give the coating its mirror-like reflectivity. In the Khumbu region of Nepal, not far from Mount Everest, it has turned the boulders black. Halfway around the world, it enabled ancient peoples to create the Nazca Lines in the Peruvian desert. These giant, elaborate images - some over 200 metres across and created over 1000 years ago - were made by simply removing rows of varnished stones to exposing the lighter stones or soil beneath.

George Merrill coined the phrase desert varnish in 1898, while working for the US Geological Survey (USGS). No one really studied it, though, until 1954, when Charles Hunt showed that the veneer forms on many different rock types - meaning that it wasn't simply a chemical production from a certain kind of rock and prompting the first questions about where it might come from (*Science*, vol 120, p 183). Hunt went on to find rock varnish in humid regions, tropical rainforests and at high altitudes in the Alps and the Rocky mountains.

Theories on how rock varnish forms weren't long in coming - and, initially at least, biology didn't get a look-in. In 1958 Celeste Engel of the USGS and Robert Sharp from the California Institute of Technology explained it as a chemical weathering phenomenon similar to iron oxide stains - red/orange coatings arising when iron particles from the air collect on the surface of rocks and bind together when made wet by dew (*Geological Society of America Bulletin*, vol 69, p 487).

It made sense to think that rock varnish had a chemical origin, since many similar-looking coatings were already known to form chemically. Silica glaze, for example, is one of the most common coatings and forms when silicic acid carried in dust and dew condenses onto rock surfaces.

Layer cake

Everything changed, though, when people saw the internal structure of rock varnish. Electron microscopic images taken by Randal Perry and John Adams at the University of Washington in Seattle in 1978 revealed an intricate layer-cake pattern, with black strips of manganese oxides alternating with orange layers of clay and iron (*Nature*, vol 276, p 489). No other rock coating combines this microlayered mixture of clays and metal oxides.

The implications here were enormous. This microstructure looked strikingly similar to that of fossil stromatolites - layered rock-like structures formed by ancient microbes as they collected sediments from seawater to build themselves a home. Though they still grow today in some isolated spots, stromatolites were one of the first life forms on Earth, dominating the fossil record from 3.5 billion years ago until about 600 million years ago.

That meant rock varnish could have a biological origin, and a flurry of investigations ensued to find out which microbes were responsible. Backing up the idea was the fact that microbes developed the ability to make a manganese oxide coat early in their evolution, to protect themselves from the harsh UV rays of the young sun.

Manganese proved pivotal three years later, for Ronald Dorn at Arizona State University in Tempe and Theodore Oberlander of the University of California, Berkeley. They found what looked like the fossilised remains of a few budding bacteria within the manganese oxide layer. Manganese concentration peaked around them, suggesting these bacteria were involved in producing it.

Dorn and Oberlander then managed to isolate two manganese-depositing microbes, *Metallogenium* and *Pedomicrobium*, from the surface of varnish samples collected in California's Mojave desert. When they added these to sterilised chips of rock in test tubes, they were able to grow a thin manganese varnish in about six months. The findings were published under the title "Microbial Origin of Desert Varnish" (*Science*, vol 213, p 1245).

That proved to be premature. The microstromatolite texture of natural rock varnish was absent in the lab-grown version, and anyway it formed way too quickly. It was around then that natural rock varnish was discovered to grow as slowly as 1 or 2 micrometres every thousand years.

Rock varnish grows at rates as slow as 1 or 2 micrometres every thousand years

Although Dorn conceded that his experiments were not conclusive proof, he believed the manganese layering had to be microbial and stuck by his theory. Two key questions remained. Why does rock varnish contain so few fossilised microbes, and how could they take so long to concentrate manganese but leave no trace of their existence?

David Krinsley might have an explanation: over thousands of years, chemical changes within the deposit could have destroyed any bacterial remains, he argues. A sedimentologist from the University of Oregon

in Eugene, Krinsley has studied dozens of rock varnish samples and in every one he has seen a scattering of fossilised bacteria. But it's still not proof that they made the varnish, he admits.

Dorn is not surprised there are so few bacteria in rock varnish, considering the time it takes to form. "My hypothesis is that very rare bacterial forms concentrate the manganese and iron," he says. He also believes the slow rate rules out chemical theories of rock varnish formation because silica glaze and other types of chemical rock coating grow in relatively rapid annual cycles.

But the real answer to the rock varnish mystery could come from a remarkable cave in New Mexico. The floor of the Fort Stanton cave is made of a sparkling white calcite "river" formed by hundreds of years of flooding - but it is the dark coatings covering the cave walls that interest rock varnish researchers.

Most of it is just simple manganese oxide minerals, but on their most recent trip to the cave, Mike Spilde of the University of New Mexico in Albuquerque and Penny Boston at New Mexico Institute of Mining and Technology in Socorro found coatings that seem to fulfil all the definitions of rock varnish - iron and manganese oxides bound together by clays, in the characteristic microstromatolite layers. The coatings were covered with bacteria known to deposit manganese. "These deposits are biological in origin," Spilde concluded when he presented the findings at the Geological Society of America meeting in Portland, Oregon, last October.

Further confirmation is needed, says Dorn, but the cave deposits "sure look like rock varnish". One difference is that the cave varnish seems to form far more rapidly: the coating is already starting to grow back in areas where Spilde's team had removed deposits a few years earlier. The cave is damp, so perhaps this helps the coating grow more rapidly and explains the incredibly slow growth rate of rock varnish in desert conditions, Spilde suggests.

Equipped for the hunt

Where does all this leave the search for life on Mars? If Earth is anything to go by, there are only three possible explanations for the shiny rocks on Mars - rock varnish, silica glaze or a simple polishing of the rocks themselves by wind-blown sand.

The latter is the easiest to discount. Martian rocks are entirely cloaked in their shiny coating, whereas natural sandblasting would polish only the windward face. To confirm matters, infrared images from Mars rovers have proved that the shiny surface is an extra coating rather than part of the rocks themselves.

Silica glaze seems unlikely too. NASA's Mars exploration rovers Spirit and Opportunity can detect silica, and in 2007, Spirit dug into the soil and found a large deposit of it, providing strong evidence that liquid water once flowed on the planet's surface. The rovers have never detected silica glaze on the rocks they have analysed, however.

Which leaves rock varnish. All the raw ingredients are known to exist on Mars - and, given the harsh UV rays that continually bombard the planet, under a protective coating might be exactly where you would expect to find evidence of life. Mars is free of many of the processes that erode rock varnish on Earth, from rain to lichens, so it might harbour evidence of ancient life millions of years old.

Under a protective coating might be exactly where you would expect to find evidence of life on Mars

The uncertainty over rock varnish's origins - and its complex structure and chemical make-up, which make it difficult to definitively detect - mean that no instrument has ever been designed specifically to search for rock varnish on Mars. It should be possible to identify some components, though.

For example, the thermal emission spectrometer that enabled Spirit to detect silica should theoretically be able to detect manganese oxides too. The mineral has never been spotted, but that might be because it is present in such small quantities compared with the underlying rock, says Steve Ruff at Arizona State University, who runs the TES instruments on the rovers. That means any signal is too low for the instrument to detect.

Both rovers are also fitted with an alpha proton X-ray spectrometer, which fires alpha particles and X-rays at rock surfaces to detect which chemical elements are present. These instruments have never detected the elevated manganese levels that would be expected in rock varnish - but again the signal could be obscured by the elements in the underlying rock. "We can't say for certain if the rock coating is manganese-enriched or not," says Harry McSween, a geologist on the Mars rover projects.

Future missions will be better equipped for the hunt. The next rover to land on the Red Planet will be NASA's Mars Science Laboratory, due to arrive in 2012. MSL can detect rock varnish, says Roger Wiens, the Los Alamos National Laboratory scientist who will run a new instrument on MSL called a laser-induced breakdown spectrometer. This will fire laser pulses at the rock coatings, and the wavelengths of light emitted as the coating atomises will tell Wiens what elements are present.

NASA is also working with the European Space Agency on the ExoMars programme, which will send two rovers in 2018, in part to hunt for evidence of life on rock surfaces. A subsequent ESA mission, Mars Sample Return - pencilled in for 2020 - might finally get the definitive answer, as for the first time the mission will bring Mars samples back to Earth.

If the cave varnish and the Mars varnish turn out to be the same as rock varnish, then Mars Sample Return might actually be bringing Martians to Earth.

Barry E. DiGregorio is a science writer and a research associate at the Cardiff Centre for Astrobiology, UK

http://www.newscientist.com/article/mg20527471.200-martian-sheen-life-on-the-rocks.html

Life's code rewritten in four-letter words

- 17 February 2010 by **Linda Geddes**

Magazine issue 2748.

Writing genetic code 2.0 (Image: Laguna Design/SPL)

A TOTALLY new genetic code has been devised, along with machinery that could make it a biological reality. It's an advance that means living cells could be persuaded to make proteins with properties that have never been seen in the natural world.

More extraordinary still, it could eventually lead to the creation of new or "improved" life forms that incorporate these materials in their tissue - possibly even organisms with bulletproof bodies.

In all existing life forms, the cell's protein-making machinery reads the four chemical "letters" of DNA - called nucleotides - in triplets to make chains of amino acids. Each three-letter word embodies the code for a single amino acid or tells the cell to stop making a protein chain.

Not any more. Jason Chin at the University of Cambridge and his colleagues have redesigned the cell's machinery so that it can also read the genetic code four letters at a time.

In this way, Chin's team has boosted the number of amino acids that can be built into a protein from the 20 covered by the existing genetic code to 276. That's because Chin's new code creates 256 possible four-letter nucleotide words or "codons", each of which can be assigned to an amino acid that doesn't currently exist in living cells.

Many such amino acids have already been made by adding different chemical groups to the basic amino acid structure. Until now, the issue has been how to incorporate large numbers of them into proteins.

To tackle this problem, Chin's team redesigned several pieces of the cell's protein-building machinery, including ribosomes and transfer RNAs (tRNAs). Together, they read the genetic code and match it up to amino acids (see diagram). The redesigned ribosomes and tRNAs operate in parallel with existing machinery, so the cell's normal protein translation machinery continues to work as normal. "It's the beginning of a parallel genetic code," says Chin.

Chin's team then inserted two quadruplet codons into the gene that codes for the common protein calmodulin, and assigned an "unnatural" amino acid to each quadruplet. When they inserted the modified gene into *E. coli*, it produced a modified calmodulin protein, incorporating the two unnatural amino acids.

What makes the new amino acids especially interesting is that they react with each other to form a different kind of chemical bond from those that usually hold proteins together. In the modified calmodulin, they led to a completely new protein structure.

Changes in heat and acidity break normal bonds between amino acids, causing proteins to lose their 3D structure. This, for instance, is why egg white changes colour and texture when cooked: bonds in the albumen in the white break and reform, changing its physical properties.

Can you watch a new form of life boot up? And can you get it to do things that natural biology can't do?

But the bonds between Chin's new amino acids are more stable - and so could allow proteins to survive a much wider range of environments. One outcome might be a new class of drugs that can be swallowed without being destroyed by the acids in the digestive tract.

That's just the beginning. In the longer term Chin's research could lead to cells that produce entirely new polymers - with the strength of Kevlar, say. Organisms made of these cells could incorporate the stronger polymers and become stronger or hardier as a result.

The next step in this direction is to design more new tRNAs that can incorporate more unnatural amino acids into protein chains. Doing so should lead to the creation of whole new classes of materials, Chin says. And because they could be churned out by bacteria grown in large fermentation vats, it would probably be a cheaper way of producing them than chemical synthesis.

"It's a very impressive advance that opens up new theoretical horizons in synthetic biology," says genomics pioneer and synthetic biologist Craig Venter, who heads his own institute in Rockville, Maryland.

Farren Isaacs of Harvard Medical School in Boston cautions that the new polymers may interfere with existing cellular processes. But as long as this does not prove an insuperable problem, Chin's achievement could pave the way for the creation of complex life forms with bizarre new properties.

"If you have a cell with DNA, RNA, proteins and a new class of polymers, can you watch a new form of life boot up with that system embedded in it?" ponders Chin. "And can you get that organism to do things that natural biology can't do because of the limited set of polymers that it can make?"

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http://www.newscientist.com/article/mg20527484.000-lifes-code-rewritten-in-fourletter-words.html

Xu Xing: Unearthing how dinosaurs became birds

- 17 February 2010 by **Phil McKenna**

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Dusting off dino feathers (Image: The IVPP)

***Xu Xing**'s dinosaur finds range from a pint-sized creature with four wings to the feathered ancestor of Tyrannosaurus rex. Between them, they have cemented the evolutionary link between dinosaurs and birds. He talks to **Phil McKenna** about his work*

How did you become interested in dinosaurs?

I grew up in a remote region in Xinjiang province. I didn't even know what a dinosaur was when I was young, not even when I was in high school. I was interested in physics, but when I got into Beijing University I was assigned to study palaeontology. I was later admitted as a graduate student to the Chinese Academy of Sciences to continue studying palaeontology. I was only interested because it meant I could stay in Beijing and didn't have to go back to Xinjiang, but early in my career I got to study some very interesting fossils. Now it's hard to imagine how I could live without dinosaurs.

Before your discoveries of feathered dinosaurs, what was the prevailing thinking on the relationship between dinosaurs and birds?

It was generally accepted that birds were descended from dinosaurs. People had found many dinosaurs that shared striking similarities with early birds, yet a few things didn't quite fit. The time sequence didn't seem to be correct, for instance. Most of these bird-like dinosaurs were from the Cretaceous, from 145 million to 65 million years ago, but the earliest known bird, *Archaeopteryx*, was much older - from the Jurassic, 200 million to 145 million years ago. Also, if birds were descended from dinosaurs, you would predict that their dinosaur ancestors should have feathers or feather-like structures. But at that time there was no fossil evidence for this.

What have you found that changed this?

In 1996 a feathered dinosaur, *Sinosauropteryx*, was discovered in north-eastern China by other Chinese researchers. So in 1997 we organised an expedition in that area, and that year we discovered a second feathered dinosaur, *Beipiaosaurus*. That specimen supported the conclusion earlier researchers had made that primitive feathers are widely distributed among bird-like dinosaurs. Then in 1998 we found another feathered genus, *Sinornithosaurus*. Collectively, these fossils were the first solid evidence of primitive feathers and they were found in dinosaurs. This provided very good evidence supporting the idea that birds evolved from dinosaurs; before this, feathers were only known in birds.

Many of the early bird-like feathered dinosaurs you describe could not fly. What did they use their feathers for?

Some believe the initial purpose of feathers was for flight, some say it was for insulation. Based on my observations, I don't think it was either. Primitive feathers were not good for flight: they were weak, hair-like structures. They were also very rigid, not an ideal structure for insulation, and they were less densely populated on the body than you would expect for insulation. It's still not entirely clear, but they appear to initially have had a display function.

The transition from dinosaurs to birds involved some unexpected turns. Do any of your other findings tell us about this process?

In 2003 we made another, even bigger discovery - a new species called *Microraptor gui*. This species is amazing because it has feathers attached to its legs as well as its forelimbs, so we called it a four-winged dinosaur.

Microraptor gui is amazing. It has feathers attached to its legs as well as its arms

This was one of the most important discoveries in understanding the transition from dinosaurs to birds because it revealed an entirely new stage of morphology during the transition. A hundred years ago, the American palaeontologist William Beebe predicted that there would be a phase in evolution involving a hypothetical four-winged "tetrapteryx". He suggested bird ancestors used not only arm feathers but also big feathers attached to their legs. But at the time there was no fossil evidence to support his theory. Our discovery of *M. gui* showed that there was a four-winged stage in the evolution of birds. Later we found others: *Pedopenna* from Inner Mongolia, and in 2009 we published on another species, *Anchiornis huxleyi*, or "near bird". They are all from different lineages but all have four wings.

What was the response to finding *M. gui*?

Its existence argues so strongly against the mainstream understanding of the dinosaur-to-bird transition that some people didn't believe it was a real specimen, or even that it was the true morphology for the species. Later, our group and others found more specimens - more than 1000 in all - of four-winged dinosaurs across a number of different lineages, which showed that it is definitely a common and important condition for the origin of birds.

What about the problematic issue of the time sequence?

Anchiornis belongs to one of the most bird-like groups of dinosaurs and lived about 160 million years ago, roughly 10 million years before the first known bird. Since 2001 we have discovered a lot of specimens from Xinjiang, where there is a huge exposure of Jurassic rocks, including the feathered dinosaur *Guanlong,* the earliest known ancestral form of *T. rex, as well as* many others that haven't yet been published. And just last month in *Science* (DOI: 10.1126/science.1182143), we described *Haplocheirus sollers* from the Alvarezsauridae, a bizarre group of bird-like dinosaurs with a large claw on one hand and very short, powerful arms. This creature has helped us solve the puzzle of how dinosaurs

came to look like birds and takes the evolution of another group of bird-like dinosaurs back a further 63 million years. Until this find we had no direct evidence that dinosaurs like this lived 160 million years ago in the late Jurassic. So in terms of establishing the time sequence, this is a huge discovery.

You bought some fossils from farmers and dealers. Is this a common practice - and do you have any concerns about it?

It is true that we purchased many of the specimens from Liaoning province - including some of the first feathered dinosaurs we found - from local farmers or dealers. The density of fossil-bearing rocks is very rich there and the farmers are also very poor. It's common in China to buy fossils, though it is not encouraged. In all other areas - Inner Mongolia, and Xinjiang and Shandong provinces - we have dug all the fossils ourselves. I don't like to buy fossils, and I will say I've bought fewer and fewer in recent years. My colleagues have the same idea. It's not good to buy fossils as it encourages people to dig illegally, and it's not good for science because fossils can be damaged in the process. But in China, so many people are digging and it's not just the museums that buy them. The most difficult decision is when you see a very scientifically important fossil: do you let it go or keep it for science? If you don't buy it, it will go somewhere else and will be a loss for science, but if you do buy it, it will encourage farmers to continue digging.

What are you working on now?

I have found four new dinosaur species that will be published soon. One species is the first known ceratopsid, or "horned dinosaur", from outside of North America. Many of my new finds are from a quarry that recently opened in Shandong province and is the largest known dinosaur graveyard in the world. We have already explored thousands of dinosaur bones and found several new species there. I'm also filming a documentary for *National Geographic*, on the evolution of feathers.

Profile

Xu Xing is at the Chinese Academy of Sciences Institute of Vertebrate Paleontology and Paleonanthropology in Beijing. He has named some 30 species of dinosaurs, more than anyone else alive, and has played a leading role in some of the most important fossil discoveries of the past decade

http://www.newscientist.com/article/mg20527475.900-xu-xing-unearthing-how-dinosaurs-became-birds.html

Primordial giant: The star that time forgot

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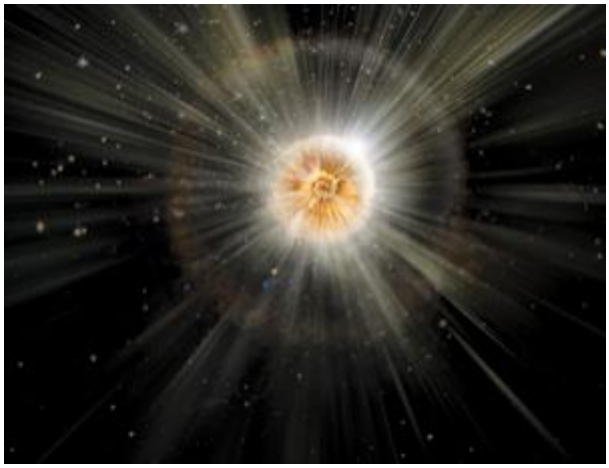

Messages from a long-lost universe (Image: Tim Gravestock)

At first, there didn't seem anything earth-shattering about the tiny point of light that pricked the southern Californian sky on a mild night in early April 2007. Only the robotic eyes of the Nearby Supernova Factory, a project designed to spy out distant stellar explosions, spotted it from the Palomar Observatory, high in the hills between Los Angeles and San Diego.

The project's computers automatically forwarded the images to a data server to await analysis. The same routine kicks in scores of times each year when a far-off star in its death throes explodes onto the night sky, before fading back to obscurity once more.

But this one did not fade away. It got brighter. And brighter. That's when human eyes became alert.

The supernova finally reached its peak brightness after 77 days. After 200 days - long after most supernovae have dwindled back into obscurity - it was still burning brightly. Only in October 2008, an unprecedented 555 days after it was first spotted, had it faded enough for the supernova hunters to call off their observations.

Digesting what they had seen took longer still. SN 2007bi, as dry protocol labelled the event, was one of the most extreme explosions ever recorded, of that there was no doubt. It was so intense that it didn't fit any model of how normal stars die. But then, it was rapidly becoming clear that, in life as in death, this had been no normal star.

If the interpretation of what popped up that April night is correct, this was a star that should not have existed, in a place where it should never have been. It was a mind-bogglingly massive star that was a throwback to a universe long since gone. It was a star that time forgot.

That picture began to emerge only after long months of monitoring the supernova's afterglow with the Samuel Oschin Telescope, a 61-year-old veteran atop Mount Palomar. This afterglow is powered by the decay of heavy radioactive elements generated in the runaway processes of nuclear fusion that occur during the initial explosion. The critical process is the decay of radioactive nickel, which quickly turns to cobalt, which in turn decays to iron, radiating gamma rays as it does so. The brightness and persistence of the afterglow reveal how much of these elements the supernova produced.

Plugging these observations into models of conventional supernovae brought a startling conclusion. To keep the supernova glowing that brightly, and for that long, the explosion must have produced 10 times more radioactive nickel than a normal supernova can muster - a discrepancy so huge that it demanded an explanation.

A clue to what was going on came in a few largely forgotten papers buried in journals from 40 years ago. In the core of any massive star, the outward pressure of photons created in nuclear fusion reactions counters the weight of the material bearing down on it, preventing the star from collapsing in on itself. Sometimes, in massive stars many times the size of the sun, gravity can eventually overwhelm this photon pressure, initiating what is known as a core-collapse, or type II, supernova. That is one of two common types of supernova. The other, called type Ia, occurs when a dying white dwarf star accretes mass from a companion star and grows unstable, igniting in a final searing fireball (see diagram).

In the old papers, astronomers speculated on what might happen to cause a truly giant star - one bigger than about 200 suns - to go supernova. In this case, they calculated, the core of the star could eventually become so hot during nuclear fusion that photons would start to convert spontaneously into pairs of particles: an electron and its antimatter doppelgänger, a positron. This would rob the star of some of the photon pressure needed to support its outer layers, causing it to collapse in on itself in a gargantuan supernova that would vaporise the star. This final titanic burst of fusion would create vast quantities of heavy radioactive elements, far larger than a conventional supernova can produce. The astronomers called it a "pair-instability" supernova.

Implausible interloper

No supernova explosion answering to this description had ever been witnessed, and the idea remained a mere twinkling in the theorists' eyes. That is, it did until Avishay Gal-Yam, an astrophysicist at the Weizmann Institute of Science in Rehovot, Israel, and his collaborators started looking at SN 2007bi. The more they compared the data with various supernova models, the more they became convinced that the pair-instability model was the answer to the conundrum this explosion posed. "Only a pair-instability supernova can produce that much radioactive nickel," says Gal-Yam. With the model, they could even calculate how big the exploding star had been: a whopping 300 times the mass of the sun (*Nature*, vol 462, p 624).

Problem solved? Not a bit of it. The finding came with a massive sting in its tail: according to all our theories and all our observations, stars that big simply should not exist.

At least, they should not exist in the kind of universe we see around us today. In the decades since the pair-instability model was born, theory and some comprehensive sweeps of the night sky have combined to show that the composition of the modern cosmos prevents stars reaching such huge sizes. The presence of appreciable quantities of what astronomers call metals - elements heavier than hydrogen and helium - causes gas clouds to collapse speedily into "pocket-sized" stars. That is why most stars today are celestial minnows, containing less mass than our sun. The absolute upper limit on a modern star, theory and observations of our galaxy agree, lies at about 150 solar masses. A monster of 300 solar masses is an implausible interloper into this settled scene.

Things were different in early cosmic times, some 13 billion years ago in the pristine universe immediately after the big bang. Back then, solar giants ruled the roost. Only hydrogen, helium and trace amounts of lithium were floating around the cosmos, and much bigger quantities of these elements had to accumulate before they fell under the spell of gravity and were pulled together to form a star. As a result, the first stars in the universe were humongous, containing anything up to several hundred solar masses.

Fossil universes

Existing before proper galaxies had been able to form, these stars lived brief, wild lives of just a few million years as they furiously burned their vast stocks of hydrogen. Yet in their violent deaths, these stars were of huge significance. As theory has it, these explosions fused the first elements heaver than hydrogen, helium and lithium. They provided the raw materials for the cosmos we see today: its galaxies, its sun-like stars, its planets and, in one insignificant corner at least, its life.

No one has ever seen these cosmic giants directly. We would dearly love to, if only to confirm the grounds for our own existence. Unfortunately, we can't. Even as they were sowing the seeds of the future cosmos, these megastars were precipitating their own demise. By increasing the metal content of the cosmos as they died, they destroyed the very conditions that nurtured them in the first place. By the end of the first few hundred million years after the big bang, metal levels were so high that stars of their like could never form again. Direct evidence for the existence of megastars lies far beyond the horizon of even our most powerful telescopes.

We would dearly love to see one of these cosmic giants directly, if only to confirm the grounds for our own existence

Or does it? If SN 2007bi is what it seems, we might have found a get-out clause: a loophole that allows us to spy if not the first megastars, then something very similar. Against the odds, the cosmic trailblazers may have lived on into the modern universe. But how?

The secret lies in where this supernova was situated: an otherwise unassuming dwarf galaxy some 1.6 billion light years away from Earth. Dwarf galaxies, as their name suggests, are runtish structures that never made it to full size. Whereas a fully formed galaxy such as our own Milky Way contains several hundred billion stars, a dwarf galaxy can have as few as just a couple of million.

Observations of the distant universe show that dwarf galaxies were once much more prevalent. "We know that the first galaxies to form were dwarfs," says Nils Bergvall of the Uppsala Observatory in Sweden. The idea is that these were the basic blocks that built up to form the much larger galaxies of today.

We also know that dwarf galaxies, even those relatively nearby which we can see as they were in comparatively recent cosmic time, have just 5 to 10 per cent of the metals that our sun has - or markedly less than one-hundredth of their total mass. The earliest dwarf galaxies may have had even less.

We have been slow to grasp the implication: that the tiniest dwarf galaxies could be pristine chunks of the early universe, preserving its composition and conditions in a cosmos that has long since moved on. Their degree of preservation could be the result of their sheer dwarfishness: because gravity within them is weaker than within a normal galaxy, a supernova exploding within it will fling the metal-rich products outwards at such speed that they mostly escape altogether.

If the original conditions of the universe were preserved in these dwarf galaxies, there would be no reason why further waves of megastars should not continually form and die within them throughout cosmic time. If it is the absence of metals that determines stellar size, behemoth stars are not restricted to the furthest reaches of the universe: they could be found in any dwarf galaxy with a low enough metal content, including places well within reach of our telescopes. It is a line of reasoning that the identification of SN 2007bi now seems to support in spectacular fashion.

The discovery of a nearby population of megastars in what amounts to suspended animation would have huge implications for stellar science. We do not understand the processes of star formation and death as well as we would like to think. "It is surprisingly difficult to get the models to agree with the observations," says Gal-Yam. He cites the example of gold, the abundance of which in the universe

essentially defies explanation, although most astronomers assume it must somehow be made in supernovae. To find some answers, we might need to look no further than nearby dwarf galaxies.

But wait a moment. If these huge living fossils have always been lurking on our cosmic doorsteps, how come we have not seen them before now? Stars that big would surely be hard to overlook, either during their tempestuous lives or spectacular deaths. Yet apart from one peculiarly luminous supernova in 1999, we have never seen anything that looks like SN 2007bi.

Part of the explanation, says Alexei Filippenko of the University of California, Berkeley, is that we have been looking in the wrong places. "Telescope time is precious, and in a pathetic dwarf galaxy there are not that many stars, so not that many opportunities for one to go supernova," he says. Astronomers have understandably focused their attention on the big galaxies that are richly stocked with stars.

Tantalising glimpse

That is now changing as fast robotic sky searches, such as the Palomar Transient Factory based at the observatory that first spotted SN 2007bi, swing into action. Such projects make no judgement about where best to look; they just keep their electronic eyes open for anything that is changing in the sky. This new strategy is already bearing fruit. "We are now tracking a number of supernovae that could also turn out to be pair-instability supernovae. But we want to be absolutely certain before we announce," says Filippenko.

Direct observations of any living megastars lurking out there are more tricky. Giant stars with their huge stocks of hydrogen and helium fuel would be so hot that most of their energy would be emitted as ultraviolet light, which is absorbed by Earth's atmosphere before it reaches ground-based telescopes. "Without seeing the ultraviolet, these stars will just hide away and look like ordinary high-mass stars," says Gal-Yam.

Because astronomers have traditionally believed that there is little of interest to see at ultraviolet wavelengths, there are no general-purpose ultraviolet space telescopes, either. The Hubble Space Telescope can see at these wavelengths, but the kind of painstaking programme to map relatively nearby dwarf galaxies would mean tying it up for thousands of hours of observation time. Gal-Yam has just submitted a proposal to do just that, but he is competing against about 40 other projects.

Hubble was serviced for the final time last year, and attention is now switching to its replacement, NASA's James Webb Space Telescope, which is scheduled for launch in 2014. But this telescope has no ultraviolet capability. "Once Hubble is gone, we are going to be totally blind," says Gal-Yam. "There is an urgency about doing this work."

At it stands, that April supernova could have been a tantalising and wholly unexpected glimpse into a universe we thought we would never see, that of the first stars, the cosmos makers. That would be an explosion to truly blow our minds.

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http://www.newscientist.com/article/mg20527470.900-primordial-giant-the-star-that-time-forgot.html

Dusty mirrors on the moon obscure tests of relativity

- 17:53 15 February 2010 by **Valerie Jamieson**, Washington DC

Something is getting in the way (Image: Tom Zagwodzki/Goddard Space Flight Center)

The Apollo astronauts knew that moon dust was troublesome stuff. Now that dust could limit our ability to find cracks in Einstein's general theory of relativity.

Many of our best tests of relativity come from lunar ranging experiments. Several times a month, teams of astronomers from three observatories blast the moon with pulses of light from a powerful laser and wait for the reflections from a network of mirrors placed on the lunar surface by the Apollo 11, 14 and 15 missions, as well as two Soviet Lunokhod landers. By timing the light's round trip, they can pinpoint the distance to the moon with an accuracy of around a millimetre – a measurement so precise that it has the potential to reveal problems with general relativity.

But now Tom Murphy from the University of California, San Diego, who leads one of the teams at the Apache Point Observatory in Sunspot, New Mexico, thinks the mirrors have become coated in moon dust. "The lunar reflectors are not as good as they used to be by a factor of 10," he says.

Photons gone missing

The fainter light is a problem for lunar ranging experiments. Out of every 100 million billion (10^{17}) photons Murphy's team fires at the moon, only a handful make it back to Earth. Most of are absorbed by Earth's atmosphere on the way to the moon and back, or miss the mirrors altogether.

Murphy first suspected two years ago that the dust problem was cutting the light down even further. He was puzzled to detect far fewer photons than he expected, even when the atmospheric conditions were perfect. His team also saw a further drop when the moon was full and used to joke about the full moon curse. This gave Murphy some clues.

He suspects that moon dust is either coating the surface of the mirrors or has scratched them. Both scenarios would increase the amount of heat the mirrors absorb, and so during a full moon, sunlight falling on the mirrors would heat them up and change their optical properties. As a result, the mirrors would not reflect light as efficiently.

Even though the moon has no atmosphere, dust can be stirred up from the surface by the impact of micrometeorites.

Traces of dust

Murphy has scoured measurements stretching back to the 1970s and found that the problem first appeared between 1979 and 1984, and has been getting worse. However he is unwilling to predict if the mirrors will deteriorate further.

The Apache Point experiment can still make measurements, but the degradation is a bigger problem for other lunar ranging experiments that use less powerful lasers. More measurements from different sites would improve the limits on general relativity.

Murphy's findings also highlight problems that astronomers might face if they ever build a telescope on the moon.

The results were reported at the American Physical Society meeting in Washington DC and have been submitted to the journal *Icarus*.

http://www.newscientist.com/article/dn18527-dusty-mirrors-on-the-moon-obscure-tests-of-relativity.html

What happens at absolute zero?

- 18:12 17 February 2010 by **Hazel Muir**

The Boomerang Nebula is the coldest natural object known in the universe, seen here by the Hubble Space Telescope (Image: ESA/NASA)

The curious things that happen at low temperatures keep on throwing up surprises. Last week, scientists reported that molecules in an ultra-cold gas can chemically react at distances up to 100 times greater than they can at room temperature.

In experiments closer to room temperature, chemical reactions tend to slow down as the temperature decreases. But scientists found that molecules at frigid temperatures just a few hundred billionths of a degree above absolute zero (−273.15°C or 0 kelvin) can still exchange atoms, forging new chemical bonds in the process, thanks to weird quantum effects that extend their reach at low temperatures.

"It's perfectly reasonable to expect that when you go to the ultra-cold regime there would be no chemistry to speak of," says Deborah Jin from the University of Colorado in Boulder, whose team reported the finding in *Science* (DOI: 10.1126/science.1184121). "This paper says no, there's a lot of chemistry going on."

New Scientist takes a look at the weird and wonderful realm of the ultra-cold.

Why is absolute zero (0 kelvin or −273.15°C) an impossible goal?

Practically, the work needed to remove heat from a gas increases the colder you get, and an infinite amount of work would be needed to cool something to absolute zero. In quantum terms, you can blame Heisenberg's uncertainty principle, which says the more precisely we know a particle's speed, the less we know about its position, and vice versa. If you know your atoms are inside your experiment, there must be some uncertainty in their momentum keeping them above absolute zero – unless your experiment is the size of the whole universe.

What is the coldest place in the solar system?

The lowest temperature ever measured in the solar system was on the Moon. Last year, NASA's Lunar Reconnaissance Orbiter measured temperatures as low as −240°C in permanently shadowed craters near the lunar south pole. That's around 10 degrees colder than temperatures measured on Pluto so far. Brrrrrrrrr.

What is the coldest natural object in the universe?

The coldest known place in the universe is the Boomerang Nebula, 5,000 light years away from us in the constellation Centaurus. Scientists reported in 1997 that gases blowing out from a central dying star have expanded and rapidly cooled to 1 kelvin, only one degree warmer than absolute zero. Usually, gas clouds in space have been warmed to at least 2.7 kelvin by the cosmic microwave background, the relic radiation left over from the big bang. But the Boomerang Nebula's expansion creates a kind of cosmic refrigerator, allowing the gases to maintain their unusual cool.

What is the coldest object in space?

If you count artificial satellites, things get chillier still. Some instruments on the European Space Agency's Planck space observatory, launched in May 2009, are frozen down to 0.1 kelvin, to suppress microwave noise that would otherwise fog the satellite's vision. The space environment, combined with mechanical and cryogenic refrigeration systems using hydrogen and helium, chill the coldest instruments to 0.1 kelvin in four sequential steps.

What is the lowest temperature ever achieved in the laboratory?

The lowest temperature ever recorded was back here on Earth in a laboratory. In September 2003, scientists at the Massachusetts Institute of Technology announced that they'd chilled a cloud of sodium atoms to a record-breaking 0.45 nanokelvin. Earlier, scientists at the Helsinki University of Technology in Finland achieved a temperature of 0.1 nanokelvin in a piece of rhodium metal in 1999. However, this was the temperature for just one particular type of motion – a quantum property called nuclear spin – not the overall temperature for all possible motions.

What weird behaviour can gases display near absolute zero?

In everyday solids, liquids and gases, heat or thermal energy arises from the motion of atoms and molecules as they zing around and bounce off each other. But at very low temperatures, the odd rules of quantum mechanics reign. Molecules don't collide in the conventional sense; instead, their quantum mechanical waves stretch and overlap. When they overlap like this, they sometimes form a so-called Bose-Einstein condensate, in which all the atoms act identically like a single "super-atom". The first pure Bose-Einstein condensate was created in Colorado in 1995 using a cloud of rubidium atoms cooled to less than 170 nanokelvin.

http://www.newscientist.com/article/dn18541-what-happens-at-absolute-zero.html

Atom smasher shows vacuum of space in a twist

- 17:27 15 February 2010 by **Rachel Courtland**
- Magazine issue 2748.

Ephemeral vortices that form in the vacuum of space may have been spotted for the first time. They could help to explain how matter gets much of its mass.Most of the mass of ordinary matter comes from nucleons – protons and neutrons. Each nucleon, in turn, is made of three quarks. But the quarks themselves account for only about 1 per cent of the mass of a nucleon. The remainder of the mass comes from the force that holds the quarks together. This force is mediated by particles called gluons.

A theory called quantum chromodynamics is used to calculate how quarks and gluons combine to give mass to nucleons, but exactly how this phenomenon works is not fully understood.

One possibility is that the fields created by gluons can twist, forming vortex-like structures in the all-pervasive vacuum of space, and when quarks loop through these vortices, they gain energy, making them heavier.

STAR find

Now the Relativistic Heavy Ion Collider (RHIC) at the Brookhaven National Laboratory (BNL) in Upton, New York, has seen signs of such vortices in fireballs that mimic conditions when the universe was just a few microseconds old.To find the vortices, a team used a detector called STAR to analyse the particles created when the collider smashes gold or copper ions head-on at high energies. This process creates a fireball that is about 4 trillion kelvin at its core, a temperature high enough to form what's known as a quark-gluon plasma.

So what has this got to do with vortices created by gluons in the vacuum of space? If two ions collide off-centre, the ensuing fireball starts rotating, creating a powerful magnetic field. If gluon-created vortices exist, this magnetic field should cause quarks in the plasma to separate in accordance with their electric charge, says Dmitri Kharzeev, a theorist at BNL who predicted the effect. That is exactly what the STAR collaboration saw: more positively charged quarks moving in one direction and more negatively charged quarks moving in another, says Nu Xu, spokesman for STAR. The findings were presented on Monday at a meeting of the American Physical Society in Washington DC.

Direct manifestation

"It's a direct experimental manifestation of a property of quantum chromodynamics that has never been seen in the laboratory before," says Krishna Rajagopal of the Massachusetts Institute of Technology. "It confirms our understanding that gluon fields can have twists."The evidence of the vortices in the vacuum of space is best seen in a quark-gluon plasma, which requires high energy collisions. The effect can be confirmed by studying the extent of quark separation at lower energies, so later this year the RHIC team plans to begin smashing ions together at lower and lower energies (*Physical Review Letters*, DOI: 10.1103/PhysRevLett.103.251601).

But it's not yet clear whether gluon-created vortices – also called instantons – appear frequently enough to account for most of the mass of nucleons. The key lies in measuring with greater precision the separation of charged quarks in the fireball seen at the RHIC. The more vortices created by gluons, the more the charged quarks should separate. This measurement could help pin down exactly how prevalent these instantons are in the present-day universe, says Kharzeev.

http://www.newscientist.com/article/dn18526-atom-smasher-shows-vacuum-of-space-in-a-twist.html

Pliable power pack will let gadgets feed on your body

- 15 February 2010 by **MacGregor Campbell**

Magazine issue 2747.

Tapping into kinetic energy (Image: tempurasLightbulb/iStock)

SHEETS of material that produce voltage when flexed could generate power from the motion of the human body.

Previous materials were either too rigid or too inefficient to be practical as pliable power generators. Now two research teams have solved the problem using different approaches. The materials could allow future medical implants to harvest their own power, by using the pulsing of arteries, for example.

Yi Qi and Michael McAlpine of Princeton University developed a way to soften up the usually inflexible crystal lead-zirconate-titanate (PZT), which is one of the most efficient piezoelectric materials known.

"People thought, 'this is a crystal'; they never thought about whether they could make it flexible," says McAlpine. But he and Qi found that when an extremely thin film of the ceramic is grown on a solid substrate and cut into strips about 5 micrometres thick, the resulting material can flex (see diagram).

These "nanoribbons" are like fibre-optic cable made using glass, says McAlpine. Being long and thin, they can still bend despite being made of a material that is rigid in bulk.

The strips were attached to conducting silicone rubber to produce a flexible sheet that converts motion to electricity about half as well as traditional, rigid PZT (*Nano Letters*, DOI: 10.1021/nl903377u).

In contrast, Chieh Chang and Liwei Lin of the University of California at Berkeley created fibres from a piezoelectric polymer called PVDF. The polymer is usually made in sheets, but the researchers spun it into fibres by drawing the molten material through a nozzle using an electric field.

This technique usually results in a fibre inside which the charged domains responsible for the material's useful properties are randomly oriented, leading them to cancel out one another's output. The Berkeley team used a strong electric field and the mechanical stress of the spinning process to line up those domains and ensure they work in unison.

When more than 40 samples were tested the fibres proved capable of converting 12.5 per cent of the mechanical energy used to deform them into electricity. Some recovered 20 per cent (*Nano Letters*, DOI: 10.1021/nl9040719). Lin says this makes them competitive with a conventional film of rigid PZT.

"Using flexible materials will open up a new field of mechanical energy harvesting," says Xudong Wang at the University of Wisconsin, Madison, who says "waste" movement is often overlooked as an energy source.

McAlpine says flexible piezomaterials of either kind could be used to make motion-powered generators to extend the battery life of medical devices like pacemakers. "You could even eliminate the battery altogether." he says.

http://www.newscientist.com/article/mg20527475.500-pliable-power-pack-will-let-gadgets-feed-on-your-body.html

Greenland's glaciers disappearing from the bottom up

- 18:00 14 February 2010 by **Shanta Barley**

A sign of trouble below? (Image: Arcticphoto/Alamy)

Water warmed by climate change is taking giant bites out of the underbellies of Greenland's glaciers. As much as 75 per cent of the ice lost by the glaciers is melted by ocean warmth.

"There's an entrenched view in the public community that glaciers only lose ice when icebergs calve off," says Eric Rignot at the University of California, Irvine. "Our study shows that what's happening beneath the water is just as important."

In the summer of 2008, Rignot's team measured salinity, temperature and current speeds near four calving fronts in three fjords in western Greenland. They calculated melting rates from this data.

Unplugged

The underwater faces of the different glaciers retreated by between 0.7 and 3.9 metres each day, representing 20 times more ice than melts off the top of the glacier. This creates ice overhangs that crumble into the sea, says Paul Holland at the British Antarctic Society.

Warming water may also be unlocking ice from the seabed, removing the buttresses that stop inland ice sliding out to sea, says Rignot. This is one way that warming oceans could be helping to shift Greenland's ice off the land and out to sea.

Glaciologist Eric Steig at the University of Washington in Seattle says the importance of bottom-melting by warm ocean water was well-known in Antarctic glaciers. "But this is the first study to strongly indicate that it is occurring in Greenland too," he says.

Journal reference: *Nature Geoscience*, DOI: 10.1038/ngeo765

http://www.newscientist.com/article/dn18520-greenlands-glaciers-disappearing-from-the-bottom-up.html

'Backward' black holes spew super-powerful jets

- 17:02 12 February 2010 by **David Shiga**

"Backwards" black holes may kick out stronger jets of matter than their standard counterparts.

Black holes are messy eaters. As they gorge on matter, they spew some of it out as jets. These jets play an important role in the evolution of the galaxies in which they occur because they heat up huge volumes of gas, preventing it from condensing to form stars. But no one knows why some jets are more powerful than others.

Using X-ray observations, a team led by Daniel Evans of the Massachusetts Institute of Technology in Cambridge studied the region around a black hole called 3C 33, which spins in the opposite direction to its orbiting discs of dust and gas. Over time, matter falling into a black hole is supposed to persuade it to rotate in the same direction as its disc, so counter-rotating black holes are thought to be rare.

This one has particularly powerful jets, perhaps because its inner disc is empty, due to the gravitational effect of the counter-rotation. The opposite motion creates the equivalent of a "headwind" in space-time for nearby matter travelling in the opposite direction, diverting it into the black hole, and leaving an empty region.

This may leave space for magnetic fields to build up enough strength to accelerate the jets, says David Garofalo of NASA's Jet Propulsion Laboratory in Pasadena.

Brian McNamara of the University of Waterloo in Canada, who was not involved in the study, says the result is intriguing, but cautions that the X-ray measurements provide only indirect evidence that the black hole is rotating backwards.

Journal reference: *The Astrophysical Journal*, DOI:10.1088/0004-637X/710/1/859

http://www.newscientist.com/article/dn18519-backward-black-holes-spew-superpowerful-jets.html

We can't look after our data – what can?

- 16:00 11 February 2010 by **Tom Simonite**

A personal collection of benign data (Image: Sam Diephuis/Getty)

Innovation is our regular column that highlights emerging technological ideas and asks where they may lead.

Last week *New Scientist* pondered the fragility of digital data stores over the very long term, in the event of a civilisation-wide calamity. But anyone worried about civilisation's chances would do well to look to their own data stores first.

Most of us today are blithely heading for our own personal data disasters. We generate and store vast volumes of information, but few of us really look after it.

"Benign neglect" is how Cathy Marshall of Microsoft Research Silicon Valley in Mountain View, California, describes the way most people treat their personal archives of digital material. It's a view formed by spending time with computer users to find out how much people value their accumulated data, how they try to protect it and whether they've succeeded.

Infinite U-Store-It

Most people adopt what she dubs "the infinite U-Store-It" approach, accumulating data haphazardly on various computers, gadgets, removable disks and online services. "If you've ever looked inside a U-Store-It you'll realise why this is a bad idea," she says. "People don't realise what they have, they just save everything and when they do clean up they don't do it systematically."

When asked, people typically say they value their data a lot. But they lose it nonetheless, more from disorganisation than from a technological catastrophe such as a hard disk failure, Marshall has found. Data can fall prey to online services or ISPs closing accounts or changing their policies, logins being lost, or simply forgetting what and where we have in physical or virtual space.

Web services – "cloud" computing – are becoming the home for much of our data: for example, people often store their photos on Flickr or business contacts on LinkedIn. Giving stewardship of our data to a third party in the cloud could be a way to keep it safe from both disaster and disorganisation.

Night-light storage

For example, computer scientists led by Ethan Miller at the University of California, Santa Cruz, are developing hardware for storage services designed to look after data that you have yet to create.

Their plan, dubbed Pergamum, is to use low-power storage "bricks" that can each make 1 terabyte of data available instantly over the web while using just 2 watts of power – roughly the same as a pair of computer speakers.

The bricks contain digital storage and processors to manage that store and coordinate with other bricks. They can be connected together to make as large a store as is necessary with very little effort, and are designed to prevent future obsolescence: they connect using standard network switches to allow today's bricks, which are built around hard disks, to work smoothly with tomorrow's flash-based bricks, or those containing storage formats as yet unknown.

Memory lane

But as well as developing cheaper, more cavernous digital U-Store-Its, we need help to explore, organise and rediscover forgotten, perhaps decades-old data.

Software developed at the library of Stanford University, California, to record stories of pioneers of early computing suggests how this might be done. The Self Archiving Legacy Toolkit can recognise places, names and other organising concepts in a person's digital "papers", such as emails, letters and research reports. It then creates a branching "mind map" linking items by people, places or ideas that they have in common, forming an interactive digest of person's life.

Such a tool could be of use to any of us now that diverse, disorganised digital archives are becoming the norm.

http://www.newscientist.com/article/dn18512-innovation-we-cant-look-after-our-data--what-can.html

Entangled photons love a bumpy ride

- 12 February 2010 by **Colin Barras**

Magazine issue 2747.

Good weather for quantum communication (Image: David Hodges/Rex Features)

ATMOSPHERIC turbulence can be a pain for plane passengers, but for entangled photons it could prove something of a boon. The particles used in quantum cryptography communication travel like a dream through a turbulent atmosphere.

In 2007, Anton Zeilinger's team at the University of Vienna, Austria, created entangled pairs of photons on a mountain top in La Palma, one of the Canary Islands, and beamed one of each pair 144 kilometres through the air to Tenerife, establishing the longest ever quantum communications channel.

We have yet to tease out all of the conditions favouring the transmission of fragile entangled photons through air, but Andrew Semenov at the Institute of Physics in Kiev, Ukraine, and Werner Vogel at the University of Rostock, Germany, think they might have found one of entanglement's allies.

They analysed the Zeilinger team's data, which included information on atmospheric conditions and the strength of the quantum link. The link strength is established by comparing the number of entangled photons that make it to their respective receiver with the number of non-entangled photons - for instance, in background light - that also reach the detector. Semenov and Vogel found that whenever the signal was particularly strong, the prevailing atmospheric conditions were turbulent (arxiv.org/abs/0909.2492). This

contrasts with standard satellite-based optical communication, which can be disrupted by atmospheric turbulence.

Turbulent airflow leads to random fluctuations in atmospheric temperature, and those make the atmosphere more or less easy for photons to traverse, says Semenov. The fluctuations will sometimes produce a "more transparent" atmosphere through which more entangled photons can travel without being scattered.

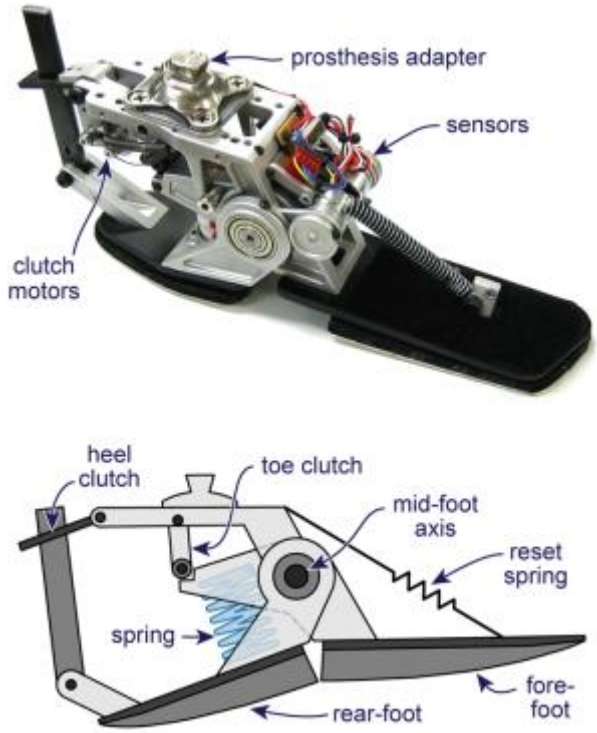
"The turbulent atmosphere is by no means [always] a better channel," says Vogel, because the random fluctuations are just as likely to make the atmosphere more opaque to the photons. But because the receivers automatically reject data if the signal is too weak and establish a connection using a strong signal only, "the fluctuations may improve the situation". "Increasing turbulence from the zero value can be useful," Vogel says.

Alessandro Fedrizzi, formerly of Zeilinger's team and now at the University of Queensland in St Lucia, Australia, says it is an "amazing result" and encouraging for the prospect of eventually setting up satellite-based quantum communication networks.

http://www.newscientist.com/article/mg20527473.600-entangled-photons-love-a-bumpy-ride.html

Fake foot with smarts boosts walking efficiency

- 16:12 17 February 2010 by **Paul Marks**



A spring in the heel captures energy from each footfall, and releases it with the correct timing to help push the foot from the ground again (Image: PLoS)

1 more image

A smart artificial foot that uses springs and electronics to recycle energy otherwise lost during walking could help people with prosthetic legs walk as efficiently as the able-bodied.

Without the ankle's springiness and ability to actively push off from the ground, amputees can expend up to twice the energy of able-bodied people when walking.

Biomechanics researcher Steven Collins at Delft University of Technology in the Netherlands, and Arthur Kuo of the University of Michigan in Ann Arbor drew on their experience of making bipedal robots and studies of the way a human foot loses and uses energy to come up with their design.

Energy drain

When the foot hits the ground during walking, it deforms as it takes our weight. The heat created by the deformation is soaked up by the foot's 200 or so muscles.

"You have to replace that lost energy when your ankle then pushes off," says Collins. "And that costs you even more energy." Artificial feet are even more wasteful of energy.

Today's artificial feet comprise long, flat carbon-fibre leaf springs hidden in a foot-like "cosmetic cell". These springs are smaller versions of the powerful running springs used by athletes like Oscar Pistorius.

But because the spring gives slightly when the user pushes down on the ground, it acts as a considerable energy leech. "You would think it would help, but it doesn't quite restore function fully," says Collins.

Smart spring

He and Kuo have addressed that by building a foot that's not only able to soak up energy on touchdown, but also has the electronic smarts to release it at just the right moment to help with a springy, more powerful push-off (see video, above).

Their system has a rear-foot section hinged to a forefoot (see diagram, right). As the rear foot contacts the ground, energy is stored in a large compressible coiled spring held in place by an electronic clutch. As the forefoot bends when the user starts to push-off for the next step, a sensor sends a signal that releases the clutch, unleashing the spring's energy to help out.

After initial safety tests on 11 able-bodied subjects wearing the prosthetic foot on a special boot (see video), the system is looking promising. "We're getting a big increase in push off – double that of a conventional prosthetic foot," says Collins.

End-user tests

It will soon move on to tests on amputees. The technology is already creating something of a buzz.

"This foot stores and uses some of the energy expended during gait that would otherwise be unrecoverable. There is no commercially-available foot like this," says Glenn Klute, a prosthetics engineer at the University of Washington in Seattle.

Klute will soon be supervising tests of the foot on 20 amputee volunteers at the Seattle Veterans Hospital. "It has strong potential to help lower-limb amputees walk farther and with less effort than the foot they're currently wearing."

Journal reference: *PLoS ONE* (DOI: 10.1371/journal.pone.0009307)

http://www.newscientist.com/article/dn18539-fake-foot-with-smarts-boosts-walking-efficiency.html

USB fingerprints identify 'pod slurping' data thieves

- 16 February 2010 by **Paul Marks**
- Magazine issue 2747.

Caught red-handed (Image: Jeffrey Coolidge/Getty)

WOULD your company know if the blueprints for its next invention had been stolen by an office interloper, who had quietly copied them onto a memory stick or an iPod? Probably not. But now a telltale "USB fingerprint" has been discovered that can identify which files have been targeted in so-called pod-slurping attacks.

Data theft via USB ports is rife, says Alexandra Brodie, an intellectual property lawyer with Wragge & Co in London. "We are encountering increasing volumes of IP theft committed this way, with companies losing their trade secrets and accumulated know-how," she says.

Pod slurpers might simply steal an individual document by copying it onto a USB stick. Hackers can also copy vast numbers of documents using document-scavenging tools such as USB Switchblade. This too springs to life when a memory stick is plugged into a PC running some versions of Windows, including XP. It then automatically copies the contents of the My Documents folder and no one is any the wiser. Now there is a way to spot such data theft.Vasilios Katos and Theodoros Kavallaris at the Democritus University of Thrace in Komotini, Greece, have been testing every make and model of USB stick and iPod/iPhone. They have discovered that each one has a distinctive transfer rate when copying data from a PC's hard drive (*Computers and Security*, DOI: 10.1016/j.cose.2010.01.002). This is due to the differences in the microcircuitry and components that go into making each type of device.

They are able to find out if files have been copied by consulting the Windows registry, which records the make and model of every USB device plugged into that computer with a time stamp. The pair then check all document folders for any files that were accessed shortly after the USB device was plugged in - the computer registry counts copying as file access.When they find a folder they suspect has been copied, they list the times the files within it were accessed. If the total time it took to access all the files matches the transfer rate of a particular USB stick or iPod plugged into the PC at that point, then it is fair to assume a pod-slurping attack has taken place.

If the time it took to access all the files matches the transfer time of a USB then it's a pod-slurping attack

Kavallaris is writing a program to automate the process of trawling the Windows registry to work out hich files have been copied to a USB stick.

Brodie thinks the team's work could help investigators. "The ability to prove that downloads have taken place will be invaluable in building a case when thefts occur."

http://www.newscientist.com/article/mg20527475.600-usb-fingerprints-identify-pod-slurping-data-thieves.html

Cars learn to keep an eye on the weather

- 03 February 2010 by **Paul Marks**

Magazine issue 2745.

How slippery when wet? (Image: Transport Image Picture Library/Alamy)

ROAD accidents could be slashed if cars had better data on weather and road conditions, according to Sony and VTT, Finland's top transport-research lab.

Erecting electronic road signs is expensive and warnings are frequently missed, says Nikolaos Georgis of the Sony Technology Center in San Diego, California.

Along with colleagues, he's filed for a US patent for an in-car computer system which contains a database of the speed limits on every road in the nation. It could be built into the satellite navigation or entertainment system, he says.If the in-car computer can then acquire a stream of local weather data, perhaps from a nearby digital TV transmitter, it could calculate new stopping distances and display or announce a new recommended speed limit. It could even assume a measure of control to prevent the car exceeding certain speeds in wet or icy conditions.

That latter option doesn't appeal to Pertti Peussa, an R&D engineer with VTT in Tampere, Finland. "What happens if you are passing a truck with an oncoming car on the horizon and suddenly your vehicle speed is lowered?"

Peussa has been working with Volvo and Fiat to find out which car sensors are best for the direct detection of adverse road conditions - and developing software that advises the driver of the appropriate speed.

With funding from the European Union, they have been pointing infrared lasers, microwave radars and cameras at the road ahead of cars to detect the surface conditions. Radar proved to be the best option as it is able to detect dry, wet, icy or snowy road surfaces 30 metres ahead. Lasers often missed ice, while low light foiled cameras.

The ultimate aim, says Peussa, is to design friction sensors that can be mounted within tyres, but they are years away, he says: the heat and shock tyres experience is "murder for sensors".

http://www.newscientist.com/article/mg20527455.600-cars-learn-to-keep-an-eye-on-the-weather.html

Digital doomsday: the end of knowledge

- 02 February 2010 by **Tom Simonite** and **Michael Le Page**
- Magazine issue 2745.

Information is stored in many forms, but will it be readable in the future?

"IN MONTH XI, 15th day, Venus in the west disappeared, 3 days in the sky it stayed away. In month XI, 18th day, Venus in the east became visible."

What's remarkable about these observations of Venus is that they were made about 3500 years ago, by Babylonian astrologers. We know about them because a clay tablet bearing a record of these ancient observations, called the Venus Tablet of Ammisaduqa, was made 1000 years later and has survived largely intact. Today, it can be viewed at the British Museum in London.

We, of course, have knowledge undreamt of by the Babylonians. We don't just peek at Venus from afar, we have sent spacecraft there. Our astronomers now observe planets round alien suns and peer across vast chasms of space and time, back to the beginning of the universe itself. Our industrialists are transforming sand and oil into ever smaller and more intricate machines, a form of alchemy more wondrous than anything any alchemist ever dreamed of. Our biologists are tinkering with the very recipes for life itself, gaining powers once attributed to gods.

Yet even as we are acquiring ever more extraordinary knowledge, we are storing it in ever more fragile and ephemeral forms. If our civilisation runs into trouble, like all others before it, how much would survive?

Of course, in the event of a disaster big enough to wipe out all humans, such as a colossal asteroid strike, it would not really matter. Even if another intelligent species evolved on Earth, almost all traces of humanity would have vanished long before.

Let's suppose, however, that something less cataclysmic occurs, that many buildings remain intact and enough people survive to rebuild civilisation after a few decades or centuries. Suppose, for instance, that the global financial system collapses, or a new virus kills most of the world's population, or a solar storm destroys the power grid in North America. Or suppose there is a slow decline as soaring energy costs and worsening environmental disasters take their toll. The increasing complexity and interdependency of society is making civilisation ever more vulnerable to such events (*New Scientist*, 5 April 2008, p 28 and p 32).

Whatever the cause, if the power was cut off to the banks of computers that now store much of humanity's knowledge, and people stopped looking after them and the buildings housing them, and factories ceased to churn out new chips and drives, how long would all our knowledge survive? How much would the survivors of such a disaster be able to retrieve decades or centuries hence?

Fogbank fiasco

Even in the absence of any catastrophe, the loss of knowledge is already a problem. We are generating more information than ever before, and storing it in ever more transient media. Much of what it is being lost is hardly essential - future generations will probably manage fine without all the family photos and videos you lost when your hard drive died - but some is. In 2008, for instance, it emerged that the US had "forgotten" how to make a secret ingredient of some nuclear warheads, dubbed Fogbank. Adequate records had not been kept and all the key personnel had retired or left the agency responsible. The fiasco ended up adding $69 million to the cost of a warhead refurbishment programme.

In the event of the power going off for an extended period, humanity's legacy will depend largely on the hard drive, the technology that functions as our society's working memory. Everything from the latest genome scans to government and bank records to our personal information reside on hard drives, most of them found inside rooms full of servers known as data centres.

Hard drives were never intended for long-term storage, so they have not been subjected to the kind of tests used to estimate the lifetimes of formats like CDs. No one can be sure how long they will last. Kevin Murrell, a trustee of the UK's national museum of computing, recently switched on a 456 megabyte hard drive that had been powered down since the early 1980s. "We had no problems getting the data off at all," he says.

Modern drives might not fare so well, though. The storage density on hard drives is now over 200 gigabits per square inch and still climbing fast. While today's drives have sophisticated systems for compensating for the failure of small sectors, in general the more bits of data you cram into a material, the more you lose if part of it becomes degraded or damaged. What's more, a decay process that would leave a large-scale bit of data readable could destroy some smaller-scale bits. "The jury is still out on modern discs. We won't know for another 20 years," says Murrell.

Most important data is backed up on formats such as magnetic tape or optical discs. Unfortunately, many of those formats cannot be trusted to last even five years, says Joe Iraci, who studies the reliability of digital media at the Canadian Conservation Institute in Ottawa, Ontario.

Iraci's "accelerated ageing" tests, which typically involve exposing media to high heat and humidity, show that the most stable optical discs are recordable CDs with a reflective layer of gold and a phthalocyanine dye layer. "If you go with that disc and record it well, I think it could very well last for 100 years," he says. "If you go with something else you could be looking at a 5 to 10 year window."

Gone in a flash

The flash-memory drives that are increasingly commonplace are even less resilient than hard drives. How long they will preserve data is not clear, as no independent tests have been performed, but one maker warns users not to trust them for more than 10 years. And while some new memory technologies might be inherently more stable than flash, the focus is on boosting speed and capacity rather than stability.

Of course, the conditions in which media are stored can be far more important than their inherent stability: drives that stay dry and cool will last much longer than those exposed to heat and damp. Few data centres are designed to maintain such conditions for long if the power goes off, though. A lot are located in ordinary buildings, some in areas vulnerable to earthquakes or flooding. And if civilisation did collapse, who knows what uses the resource-starved survivors might find for old hard drives?

The physical survival of stored data, however, is just the start of the problem of retrieving it, as space enthusiasts Dennis Wingo and Keith Cowing have discovered. They have been leading a project, based at NASA's Ames Research Center in Moffett Field, California, to retrieve high-resolution images from old magnetic tapes. The tapes contain raw data sent back from the five Lunar Orbiter missions in the 1960s. At the time, only low-resolution images could be retrieved. The tapes were wrapped in plastic, placed in magnetically impervious metal canisters and remain in pristine condition. "It is a miracle from my experience with similar commercial tapes of a similar age," says Wingo.

Biggest challenge

But to get the raw data off the tapes, the team first had to restore old tape drives saved by a former NASA employee. That was the biggest challenge, says Cowing. "There was a lizard living inside one of them." Once they began to retrieve the raw data, converting it into a usable form was only possible after a three-month search uncovered a document with the "demodulation" equations.

If today it takes a bunch of enthusiasts with plenty of funding many months to retrieve the data from a few well-preserved magnetic tapes, imagine the difficulties facing those post-catastrophe. Even with a plentiful supply of working computers to read hard drives, recovering data would not be easy. Much data nowadays is encrypted or readable only using specialised software. And in a data centre left untouched for 20 or 30 years, some drives would need disassembling to retrieve their data, says Robert Winter, a senior engineer with Kroll Ontrack Data Recovery in Epsom, Surrey, UK, which in 2003 rescued the data on a hard drive from the space shuttle Columbia.

Indeed, rescuing data if things go wrong can be tricky even in today's fully powered world. Last year, for instance, after some servers malfunctioned, it took Microsoft many weeks to recover most of the personal data of users of Sidekick cellphones.

Post-catastrophe, the lack of resources - of people, expertise, equipment - might be a far bigger obstacle than the physical loss of data. And resources are likely to be scarce. Restarting an industrial civilisation might be a lot harder the second time round, because we have used up most of the easily available resources, from oil to high-grade ores.

Would the loss of most of the data stored on hard drives really matter? After all, much of what we have inherited from past civilisations is of little practical use: the Venus Tablet of Ammisaduqa, for instance, consists largely of astrological mumbo jumbo. Similarly, an awful lot of what fills up the world's servers, from online shops to the latest celeb videos, seems dispensable too.

Even the value of much scientific data is questionable. What use would it be knowing the genome sequence of humans and other organisms, for instance, without the technology and expertise needed to exploit this knowledge? With some scientific experiments now generating petabytes of data, preserving it all is already becoming a major challenge. The vast quantity of material will be a problem for anyone

trying to recover whatever they regard as important: while it is relatively easy to find a book you are after in a library, there is usually no way to be sure what's on a hard drive without revving it up.

Top of the pops

What's more, what is likely to survive the longest from today's digital age is not necessary the most important. The more copies - backups - there are of any piece of data, the greater the chances of its survival, discovery and retrieval. Some data is much copied because it is so useful, like operating systems, but mostly it is down to popularity.

That means digital versions of popular music and even some movies might survive many decades: Abba might just top the pop charts again in the 22nd century. However, there are far fewer copies of the textbooks and manuals and blueprints containing the kind of distillation of specialised knowledge that might matter most to those trying to rebuild civilisation, such as how to smelt iron or make antibiotics.

Perhaps the most crucial loss will occur after half a century or so, as any surviving engineers, scientists and doctors start to succumb to old age. Their skills and know-how would make a huge difference when it comes to finding important information and getting key machinery working again. The NASA tape drives, for instance, were restored with the help of a retired engineer who had worked on similar systems. Without expert help like this, retrieving data from the tapes would have taken a lot longer, Cowing says.

A century or so after a major catastrophe, little of the digital age will remain beyond what's written on paper. "Even the worst kind of paper can last more than 100 years," says Season Tse, who works on paper conservation at the Canadian Conservation Institute. The oldest surviving "book" printed on paper dates from AD 868, he says. It was found in a cave in north-west China in 1907.

A century or so after the power goes off, little will remain of the digital age except what's on paper

Providing books are not used as a handy fuel, or as toilet paper, they will persist for several hundred years, brittle and discoloured but still legible. Again, though, the most popular tomes are the most likely to survive. Imagine risking your life exploring dangerous ruins looking for ancient wisdom only to find a long-hidden stash of *Playboy* magazines.

It is not just what survives but the choices of those who come after that ultimately decide a civilisation's legacy, however. And those doing the choosing are more likely to pick the useful than the trivial. A culture of rational, empirical enquiry that developed in one tiny pocket of the ancient Greek empire in the 6th century BC has survived ever since, says classicist Paul Cartledge of the University of Cambridge, despite not being at all representative of the period's mainstream culture.

As long as the modern descendant of this culture of enquiry survives, most of our scientific knowledge and technology could be rediscovered and reinvented sooner or later. If it does not survive, the longest-lasting legacy of our age could be all-time best-sellers like *Quotations from Chairman Mao*, *Scouting for Boys* and *The Lord of the Rings*.

Store it for millennia

The current strategy for preserving important data is to store several copies in different places, sometimes in different digital formats. This can protect against localised disasters such as hurricanes or earthquakes, but it will not work in the long run. "There really is no digital standard that could be counted on in the very long term, in the scenario that we drop the ball," says Alexander Rose, head of The Long Now Foundation, a California-based organisation dedicated to long-term thinking.

Part of the trouble is that there is no market in eternity. Proposals to make a paper format that could store digital data for centuries using symbols akin to bar codes have faltered due to a lack of commercial interest and the challenge of packing the data densely enough to be useful.

Perhaps the only data format that comes close to rivalling paper for stability and digital media for data density is the Rosetta Disk. The first disc, made in what its creators call 02008, holds descriptions and texts of 1000 languages.

The nickel discs are etched with text that starts at a normal size and rapidly shrinks to microscopic. At a size readable at 1000 times magnification, each disc can hold 30,000 pages of text or images. The institute is considering creating a digital version using a form of bar code.

If we did have a way to store digital data long-term, the next question would be what to preserve, and how to keep it safe but easily discoverable.

Tom Simonite is a technology news editor at New Scientist

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http://www.newscientist.com/article/mg20527451.300-digital-doomsday-the-end-of-knowledge.html

Chagos marine protection plan condemned as unethical

- 11:55 17 February 2010 by **Fred Pearce**

Coral reefs but no Chagossians (Image: NASA)

Conservationists are at war over a British plan to create a marine protection zone around a large chunk of surviving empire in the Indian Ocean. The zone, twice the size of Britain, would cover much of the Chagos archipelago, one of the most unspoiled coral reef systems in the world.

This week the world's foremost conservation science body, the International Union for Conservation of Nature (IUCN), was in ferment after announcing support for the plan in spite of warnings from its own lawyers that the scheme was unethical.

The archipelago is claimed by neighbouring Mauritius, and the UK has promised to hand the islands over when it has no further use for them.

Meanwhile the largest island, Diego Garcia, is home to a major US military base and is not covered by the proposed zone. In the 1960s, the UK expelled 1500 Chagossians to make way for the base – an act that Peter Sand of the Institute of International Law, at the University of Munich, Germany, who has campaigned for the Chagossians, says "undoubtedly constitutes a violation of international law."

Severely unethical

Last Thursday, the IUCN, ignoring protests from Mauritius, formally backed the British plan, calling for "full protection" of the reserve. But in emails seen by *New Scientist*, several members of the IUCN's ethics group, part of its Commission on Environmental Law, have condemned the move. They include the chair of the group, Klaus Bosselmann, director of New Zealand Centre for Environmental Law at the University of Auckland.. Bosselmann said that IUCN support for the plan "violates IUCN's own commitments towards sustainability" because the plan would "invalidate… the right of the Chagos

islanders to return" to those parts of the archipelago covered by the zone. He adds that for IUCN to back their permanent exclusion from the islands is "is severely unethical and against everything the international conservation movement stands for".

The Chagossians, who today number more than 4000, mostly live in Mauritius, the Seychelles and the UK. In 2008, the islanders published proposals to resettle the islands.

Remarkable reefs

The plan for a marine reserve is open to public consultation until 5 March. UK foreign secretary David Miliband said: "This is a remarkable opportunity for the UK to create one of the world's largest marine protected areas and double the global coverage of the world's oceans benefiting from full protection."

British scientists meeting to discuss the plan in Southampton last August compared the conservation value of the archipelago to the Great Barrier Reef or the Galapagos islands.

IUCN's director-general Julia Marton-Lefèvre told *New Scientist* the IUCN's position "in no way takes or endorses a position with regard to the sovereignty of the archipelago". She denied that the creation of the reserve would prevent the return of the Chagossians and called for consultation with "all stakeholders".

http://www.newscientist.com/article/dn18536-chagos-marine-protection-plan-condemned-as-unethical.html

SETI opens up its data to 'citizen scientists'

- 23:26 11 February 2010 by **Amanda Gefter**, Long Beach, California

The SETI Institute uses a set of antennas called the Allen Telescope Array to listen for alien radio signals (Image: SETI Institute)

You are officially invited to join the search for extraterrestrial life. And no, that doesn't mean you should head to Kansas and lie in a cornfield awaiting the mothership to scoop you up. All you have to do is log on to SETIQuest.org, which went live on Wednesday. The site's launch was announced at the TED 2010 conference currently underway in Long Beach, California.

SETIQuest is the product of astronomer Jill Tarter's TED Prize wish. After being awarded the TED Prize last year, Tarter was given the opportunity to make a single wish before an auditorium full of the top names in technology and design. Tarter wished that they would "empower Earthlings everywhere to become active participants in the ultimate search for cosmic company".

With SETIQuest, Tarter and TED are making that happen. The website will make vast amounts of SETI data available to the public for the first time. It will also publish the SETI Institute's signal-detection algorithm as open source code, inviting brilliant coders and amateur techies to make it even better.

"With available cloud storage and processing resources, we can provide digital signal processing experts and students with a lot of raw data … and invite them to develop new algorithms that can find other types of signals that we are now missing," the website explains.

Even if you're not a coder, you can still take the opportunity to search for ET using nothing more than the naked eye. "Citizen scientists" can visually search the data for anything that looks suspiciously like something other than white noise. Should you spot something anomalous, alert the global community. If enough citizen scientists agree that something looks fishy, their collective concern will direct SETI's telescopes to zoom in on the questionable patch of sky.

Who knows – you just might play a part in a discovery that changes history.

http://www.newscientist.com/article/dn18516-seti-opens-up-its-data-to-citizen-scientists.html

Ancient giant cattle genome first

By Steven McKenzie
Highlands and Islands reporter, BBC Scotland news website

Scientists have analysed the DNA of ancient giant European wild cattle that died out almost 400 years ago.

They have determined the first mitochondrial genome sequence from aurochs (*Bos primigenius*) from bone found in a cave in England.

Mitochondrial DNA (mtDNA) is passed down from a mother to her offspring.

One of the researchers involved, Dr Ceiridwen Edwards, has previously investigated the remains of a polar bear found in the Scottish Highlands. The work was carried out at the University College Dublin's Animal Genomics Laboratory and Conway Institute using new technology that allows billions of base pairs of DNA to be sequenced.

The technology was similar to that used to analyse human hair preserved in Greenland's permafrost to give clues to what the owner, who lived 4,000 years ago, looked like.

The research has been published in scientific journal PloS ONE.

" **The aurochs were larger and maybe people didn't really want to mess with them** "
Dr Ceiridwen Edwards

The aurochs DNA was extracted from well-preserved bone recovered from a cave site in Derbyshire and radiocarbon-dated to the Mesolithic period more than 6,000 years ago.

The bone pre-dates the farming of animals in Britain by more than 1,000 years.

Dr Edwards said a project was now under way to sequence and assemble a complete aurochs nuclear genome by the end of the year.

While there are many copies of mtDNA to be found in cells there are only two copies of nuclear DNA - one from the father and one from the mother - making it harder to find.

Previous genetic studies have suggested most modern livestock are descended from cattle that arrived in Europe from the Neolithic Near East. However, some aurochs may also have been domesticated.

Hunting range

Dr Edwards said the larger cattle were possibly harder for early farmers to manage.

She said: "My personal theory is the Near East cattle were smaller and more docile and easier to domesticate. The aurochs were larger and maybe people didn't really want to mess with them."

Aurochs were found in many parts of Great Britain, but not Ireland, and also populated most of Eurasia.

The species became extinct when a female animal died in a forest in Poland in 1627.

Roman general and dictator Julius Caesar was said to have been impressed by the size of aurochs.

Adolf Hitler wanted to recreate the cattle through selective breeding as a symbol of the Third Reich's belief in racial superiority. Herman Goering, one of his commanders, wanted to introduce the animal to a hunting range planned for conquered Eastern Europe territories.

Polar bear

Scientists based at University College Dublin, Trinity College Dublin and Oxford, Sheffield and Leeds universities collaborated on the latest research and contributed to the paper published in PloS ONE.

The senior author is the project's coordinator Prof David MacHugh, of the Animal Genomics Laboratory.

The researchers hope funding will be secured to reopen the Ancient Biomolecules Centre at Oxford where work on aurochs genome sequencing could be further developed. Previously, Dr Edwards attempted to carry out DNA analysis of a sample taken from what are believed to be the only polar bear remains to have been found in Britain.

She had hoped to compare the DNA of the animal found in the Bone Caves at Inchnadamph in Sutherland with that of modern polar bears. However, last February, she said there was not enough DNA left in the sample for an analysis to be done.

It was thought the bear was washed into the caves 18,000 years ago. The skull was found in 1927 and is held in the collections of the National Museum of Scotland in Edinburgh.

Story from BBC NEWS:
http://news.bbc.co.uk/go/pr/fr/-/2/hi/uk_news/scotland/highlands_and_islands/8516598.stm

Published: 2010/02/17 11:50:26 GMT

Acupuncture 'may cut period pain'

Acupuncture may be an effective way of easing severe period pain, a South Korean review of 27 studies suggests.

Researchers said there was "promising evidence" for acupuncture in treating cramps, but that more work was needed.

In the British Journal of Obstetrics and Gynaecology, they noted two studies found little difference between real and sham acupuncture in treating pain.

Acupuncture is a less contentious form of complementary medicine than some, but its value is still disputed.

Period pain can be severe in some women and may be accompanied by nausea, diarrhoea, migraine and backache. Common treatments include pain killers, applying heat and exercise - although a recent study questioned the efficacy of the latter.

This latest review involved 27 studies - which included nearly 3,000 women. They addressed a variety of forms of acupuncture - from classical to acupoint injection.

" **Complementary therapies should not be used exclusively, at the expense of conventional treatment, unless significant improvements have been made and your doctor tells you otherwise** "
Professor Philip Steer BJOG

Traditional acupuncturists insert needles in acupuncture points located along what they describe as "energy meridians" - a concept for which many scientists say there is no evidence. Sham acupuncture places needles away from these points.

It is not clear whether either form alleviates pain as a result of the placebo effect - the very ritual of undergoing acupuncture - or cause subtle changes in the nervous system and brain activity which can be beneficial.

Nice backs needles

The analysis by the team from Kyung Hee Medical Centre found that patients with severe period pain reported a greater reduction in their symptoms when using acupuncture compared with pharmacological treatments.

But they stressed there were methodological flaws in some studies, and that the findings did need to be interpreted with caution. Nevertheless, there was "promising evidence", they wrote.

In the UK, the National Institute for Health and Clinical Excellence (Nice) has backed the use of acupuncture in the treatment of low back pain - a move welcomed by some but criticised by those who say there is little evidence for its efficacy.

The editor-in-chief of the BJOG, Professor Philip Steer, noted that some women had period pain, also known as primary dysmenorrhoea, so badly they were "unable to function normally".

"Women with primary dysmenorrhoea should consult their GPs or gynaecologists on the best treatment available to them. Complementary therapies should not be used exclusively, at the expense of conventional treatment, unless significant improvements have been made and your doctor tells you otherwise."

Story from BBC NEWS:
http://news.bbc.co.uk/go/pr/fr/-/2/hi/health/8518745.stm

Published: 2010/02/17 01:55:06 GMT

Southern African Genomes Sequenced: Benefits for Human Health Expected

This image shows a group of hunters from the Ju/'hoansi tribe in the Namibian Bush. The indigenous hunter-gatherers of southern Africa, often referred to as Bushmen, represent the oldest known lineage of modern man. By sequencing the genomes of four Bushmen and one Bantu representative from Southern Africa, researchers led by Stephan Schuster at Penn State University in the United States and Vanessa Hayes at the University of New South Wales in Australia show that Bushmen have more genetic differences between each other than for example, do a European and Asian. The inclusion in current databases of the Bushman and Bantu genomes sequenced by Stephan Schuster et al. will ensure the inclusion of Southern Africans in medical-research efforts. (Credit: Stephan C. Schuster, Penn State University)

ScienceDaily (Feb. 18, 2010) — Human genomes from Southern African Bushmen and Bantu individuals have been sequenced by a team of scientists seeking a greater understanding of human genetic variation and its effect on human health. The study's findings will be published in the journal *Nature* on 18 February 2010. The research was completed by scientists from American, African, and Australian research institutions, with support from Penn State University in the United States and from several U.S. companies that market DNA-sequencing instruments.

"We sequenced the personal genomes of four Bushmen participants who are tribal leaders from their communities and are at least 80 years of age, and from one Bantu participant who is in his late 70s," said Stephan Schuster, a professor at Penn State and a co-leader of the project. The *Nature* paper reveals the identities of each of these five participants. The other co-leader, Vanessa Hayes of the University of New South Wales, who also is a group leader at Children's Cancer Institute Australia, added, "The Bantu participant is Right Reverend Archbishop Desmond Tutu who, through his Tswana and Nguni ancestry, is an ideal representative for most Southern Africans."

The study identified 1.3-million genetic variants that scientists previously had not observed. These genetic variations reveal that Southern Africans are quite distinct genetically from Europeans, Asians, and West Africans. The study also reveals striking levels of genetic differences among the individual study participants. Webb Miller, professor of biology and computer science at Penn State, who performed the comparative analysis of the genomes, underscores the genetic uniqueness of the Bushmen by saying, "On average, there are more genetic differences between any two Bushmen in our study than between a European and an Asian. To know how genes affect health, we need to see the full range of human genetic variation, and Southern Africa is the place to look."

This study used three new sequencing technologies, which deliver DNA sequences with unprecedented economy and speed. Tim Harkins, who led the study's industry partners, said, "This project provides a unique opportunity to compare the strengths of current sequencing technologies, and it demonstrates that their combination results in data that is more accurate than from projects using only one of these methods." As sequencing technologies evolve, the number of genomic studies is growing exponentially.

"Human genomics is becoming a realistic and powerful medical resource that will gain momentum in 2010," Schuster said.

A nearly life-long medical history accompanies each of the study's five personal genomes, facilitating the identification of genetic differences that may have contributed to particular health conditions. The researchers expect that these genomes will enable more accurate identification of diseases caused by rare genetic variants in Southern Africans and also in the global human population. To date, a genome-wide approach to identifying genetic disease susceptibility has disproportionally benefited the Western World in comparison to the African continent but "As a result of this project," Hayes said, "Southern Africans will immediately be included in genome-wide disease association studies, increasing our ability to examine regionally significant diseases."

Because the research team has made the the five genomes sequenced in its study freely available, the scientists expect that Southern Africans will be better represented in future studies of how genetic variation influences the effectiveness of drugs -- a research field known as pharmocogenomics, which relies on human genome sequences and is considered by many to be the future of drug design. "To make our results easier to use than earlier genome sequences, we have established freely available Internet servers at Penn State," Miller said. Inclusion in pharmocogenomic studies is expected to benefit Southern Africans, who often have been poorly represented in pharmaceutical trails and who suffer from population-based differences in the effectiveness of drugs, such as anti-viral treatments for HIV/AIDS. The new data also is expected to help Southern African scientist and Southern African entrepreneurs to develop appropriate treatments when world-wide approaches fail locally.

The Bushmen that participated in this study are the first people whose genomes have been sequenced that still practice a hunter/gatherer lifestyle, enabling scientists to correlate the unique physiology of Bushmen with the genetic variants detected in this study. "The availability of Bushman and Southern African Bantu genomes permits researchers to examine one of the few remaining instances in the world of coexisting foraging and farming groups," said Schuster. The study identified several genetic adaptations in the Bushmen that make them ill-suited to certain perils of an agricultural lifestyle, including high-fat diets and exposure to malaria.

The research, which involved 50 investigators, was led by Penn State University. Other institutions participating in the study include the Children's Cancer Institute Australia, the University of New South Wales, the University of Washington, the Human Genome Sequencing Center at Baylor College of Medicine, Harvard Medical School, the University of Limpopo in the Republic of South Africa, Cornell University, the Genome Center of Washington University in St. Louis, the Broad Institute, the Sperling Foundation, and the National Human Genome Research Institute, along with supporters in Namibia. Industrial partners of the study include Roche Diagnostics Corporation and Applied Biosystems, with several additional U.S. companies having opted to join the ongoing project in the future.

Story Source:

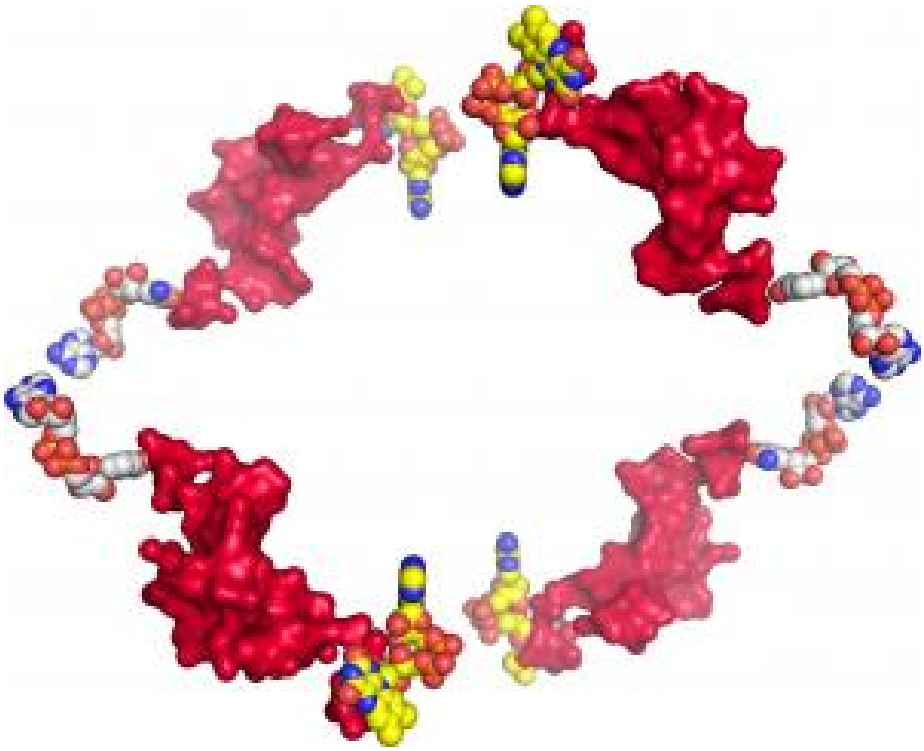
Adapted from materials provided by Penn State, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Schuster et al. **Complete Khoisan and Bantu genomes from southern Africa**. *Nature*, 2010; 463 (7283): 943 DOI: 10.1038/nature08795

http://www.sciencedaily.com/releases/2010/02/100217131123.htm

Scientists Find Donut-Shaped Structure of Enzyme Involved in Energy Metabolism



In humans, proline is important for suppression of cancer, cell death and oxidation. Understanding the structure of this enzyme will help scientists better understand how it functions and develop drugs that may inhibit its catalytic function. (Credit: Image courtesy of University of Missouri-Columbia)

ScienceDaily (Feb. 18, 2010) — If subway terminals didn't exist and people had to exit subway stations to switch subway lines, transit time would increase. People also may encounter distractions, such as grabbing a cup of coffee, instead of getting on the other line. Molecules also use "terminals" to save transit time during enzyme-catalyzed processes.

Using advanced X-radiation techniques, University of Missouri researchers were able to visualize one of these terminals inside of an enzyme that degrades proline, which is an amino acid that has a central role in metabolism. In humans, proline is important for suppression of cancer, cell death and oxidation. Understanding the structure of this enzyme will help scientists better understand how it functions and develop drugs that may inhibit its catalytic function.

"This is an aesthetically interesting enzyme that resembles a donut-shaped ring," said John Tanner, professor in the Department of Chemistry and the Department of Biochemistry. "Hidden under the surface of the protein is a system of tunnels and rooms -- like a subway system for molecules. The purpose of this system is to provide an interior passageway connecting the two catalytic sites of the enzyme. The movement of reactant molecules through this passageway is known as channeling, which makes enzymes efficient by isolating the reactants from other enzymatic reactions. Channeling potentially allows for decreased transit time between catalytic sites and protection from competing enzymatic reactions. The reactions occur without the reactants ever leaving the confines of the protein, which is efficient."

In the study, several proline-degrading proteins were screened for their ability to crystallize. A crystal is needed in order to perform X-ray diffraction experiments, which provide high resolution images of the protein's three-dimensional structure. Additional studies using small-angle X-ray scattering and

centrifugation provided crucial information about the protein's donut shape. These techniques help researchers determine the structure and composition of the enzyme.

"The complementary methods of the X-ray crystallography, small-angle X-ray scattering, and centrifugation gave us a whole picture of the structure of the enzyme," Tanner said. "Knowing the structure of the enzyme helps us understand the function of the enzyme. Once we know an enzyme's structure, we can begin to interpret other important data, such as the enzyme's role in specific reactions, how its activity is controlled and how a drug could inhibit the enzyme."

Story Source:

Adapted from materials provided by University of Missouri-Columbia.

Journal Reference:

1. Srivastava et al. **Crystal structure of the bifunctional proline utilization A flavoenzyme from Bradyrhizobium japonicum**. *Proceedings of the National Academy of Sciences*, 2010; DOI: 10.1073/pnas.0906101107

http://www.sciencedaily.com/releases/2010/02/100216101155.htm

Upside-Down Answer for Deep Mystery: What Caused Earth to Hold Its Last Breath?

Volcano eruption (Reunion island, Indian Ocean). (Credit: iStockphoto)

ScienceDaily (Feb. 18, 2010) — When Earth was young, it exhaled the atmosphere. During a period of intense volcanic activity, lava carried light elements from the planet's molten interior and released them into the sky. However, some light elements got trapped inside the planet. In the journal *Nature*, a Rice University-based team of scientists is offering a new answer to a longstanding mystery: What caused Earth to hold its last breath?

For some time, scientists have known that a large cache of light elements like helium and argon still reside inside the planet. This has perplexed scientists because such elements tend to escape into the atmosphere during volcanism. However, because these elements are depleted in the Earth's upper mantle, Earth scientists are fairly certain the retained elements lie in a deeper portion of the mantle. Researchers have struggled to explain why some gases would be retained while others would rise and escape into the air. The dominant view has been that the lowermost mantle has been largely isolated from the upper mantle and therefore retains its primordial composition.

In the new study, a team of researchers from Rice, the University of Michigan and the University of California-Berkeley suggests that a particular set of geophysical conditions that existed about 3.5 billion years ago -- when Earth's interior was much warmer -- led to the formation of a "density trap" about 400 kilometers below the planet's surface. In the trap, a precise combination of heat and pressure led to a geophysical rarity, an area where liquids were denser than solids.

Today, liquids generated in the mantle are less dense than solids and therefore rise to the surface to form volcanoes. However, several billion years ago, a hotter mantle permitted deeper melting and generated dense liquids that stalled, crystallized and eventually sank to the bottom of the mantle.

"When something melts, we expect the gas to get out, and for that reason people have suggested that the trapped elements must be in a primordial reservoir that has never melted," said lead author Cin-Ty Lee, associate professor of Earth science at Rice. "That idea's become problematic in recent decades, because there's evidence that suggests all the mantle should have melted at least once. What we are suggesting is a mechanism where things could have melted but where the gas does not escape because the melted material never rises to the surface."

Lee said the rise of less dense, melted material from Earth's interior is the process that created Earth's crust. Suggesting that melted material might sink instead literally turns conventional wisdom on its head. But the "upside-down" model can explain several geochemical and geophysical oddities in addition to the trapped gases, which suggests that it is a plausible hypothesis.

"I hope this generates a lot of interest," Lee said. "There are seismic methods that can be used to test our idea. Even if we turn out to be wrong, the tests that would be needed to falsify our hypothesis would generate a lot of new information."

Research co-authors include Peter Luffi, Tobias Höink and Rajdeep Dasgupta, all of Rice, Michigan's Jie Li and UC-Berkeley's John Hernlund. The research was supported by the Packard Foundation and the National Science Foundation.

Story Source:

Adapted from materials provided by Rice University, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Cin-Ty A. Lee, Peter Luffi, Tobias Höink, Jie Li, Rajdeep Dasgupta & John Hernlund. **Upside-down differentiation and generation of a 'primordial' lower mantle**. *Nature*, 2010; 463 (7283): 930 DOI: 10.1038/nature08824

http://www.sciencedaily.com/releases/2010/02/100217131140.htm

Obesity -- Mild or Severe -- Raises Kidney Stone Risk

ScienceDaily (Feb. 18, 2010) — Obesity in general nearly doubles the risk of developing kidney stones, but the degree of obesity doesn't appear to increase or decrease the risk one way or the other, a new study from Johns Hopkins shows.

"The common thinking was that as weight rises, kidney stone risk rises as well, but our study refutes that," says study leader Brian R. Matlaga, assistant professor of urology at the Johns Hopkins University School of Medicine and director of stone diseases and ambulatory care at Hopkins' James Buchanan Brady Urological Institute. "Whether someone is mildly obese or morbidly obese, the risk for getting kidney stones is the same."

The findings are published in the February *Journal of Urology*.

Over the last decade, several epidemiological studies have shown a strong connection between obesity and kidney stone disease. However, as obesity continues to rise worldwide, Matlaga and his colleagues wondered whether different subcategories of obesity, ranging from mildly to morbidly obese, presented different risks.

To answer the question, the researchers used a national insurance claims database to identify 95,598 people who had completed a "health risk assessment" form with information about their body mass index (BMI), a measure of body fat calculated by dividing weight by height, and a general indicator of underweight, healthy weight, or overweight. The database, which spanned over a five-year period from 2002 to 2006, also had encoded information indicating whether these individuals had been diagnosed with kidney stone disease.

Using a definition of obesity as having a BMI greater than 30 kg/m2 (which, in English measurements, corresponds to a 5 foot tall person who weighs 153 pounds, or a 6 foot tall person who weighs 221 pounds), the researchers calculated the incidence of kidney stones in people who were non-obese and in those who were obese. Among the non-obese individuals, 2.6 percent were diagnosed during the study period with kidney stones, compared to 4.9 percent of the obese individuals. When the investigators arranged those in the obese group by their BMIs, ranging from above 30 kg/m2 to more than 50 kg/m2, they found that the increased risk remained constant, regardless of how heavy the individuals were.

Matlaga says that he and his colleagues aren't sure why obese people are more at risk for kidney stones, though metabolic or endocrine factors unique to obesity are likely reasons, along with dietary factors such as a high-salt diet. The researchers plan to study these potential risk factors in subsequent studies.

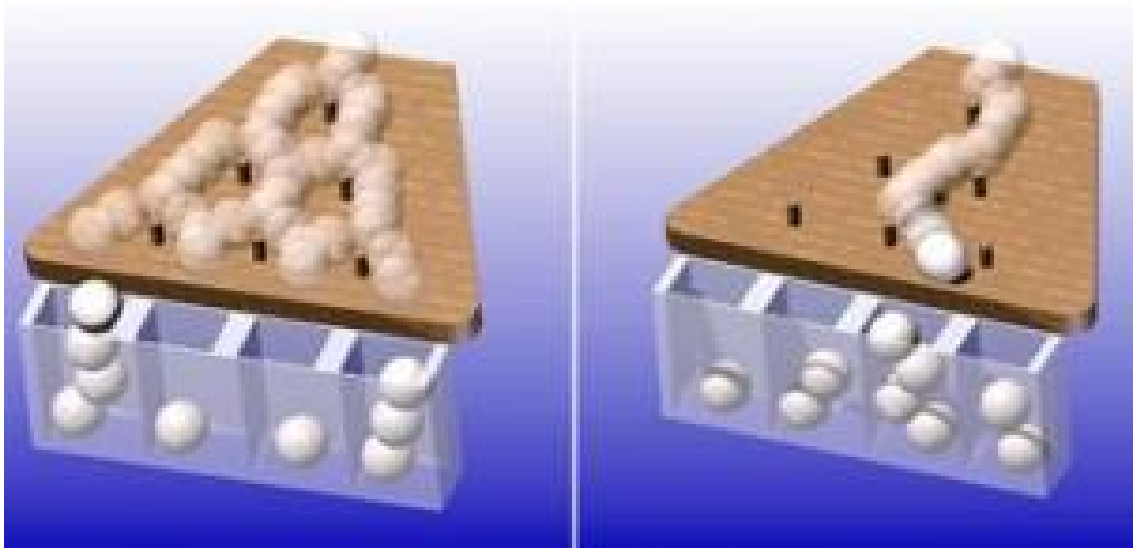
Other researchers who participated in this study include Michelle J. Semins, M.D., Andrew D. Shore, Ph.D., Martin A. Makary, M.D., M.P.H., Thomas Magnuson, M.D., and Roger Johns, M.D., M.P.H., all of the Johns Hopkins University School of Medicine.

Story Source:

Adapted from materials provided by Johns Hopkins Medical Institutions, via EurekAlert!, a service of AAAS.

http://www.sciencedaily.com/releases/2010/02/100217182350.htm

Experiment Investigates Random Motion of Quantum Particles



Everywhere and nowhere: A sphere with quantum properties can roll in any direction on a Galton board. At the end, there is a higher probability that it will be found at the edges. In a classical experiment, there is a higher probability that the ball's random path will end in the middle. (Credit: MPI for the Science of Light)

ScienceDaily (Feb. 18, 2010) — Life would sometimes be so much easier if we were quantum particles. For example, if we were trying to find our way out of a strange town allowing chance telling us which way to go at every intersection. As objects of classical physics, this would mean becoming more and more lost in the centre of the road network. If we were particles that obeyed the laws of quantum mechanics, we would sooner or later find our way to the edge of town on the randomly-chosen route.

An international team headed by researchers at the Max Planck Institute for the Science of Light has now proven this experimentally. They have used polarized light -- light waves which oscillate in a particular plane -- to design a simple model for a quantum physical random walk. Their experiments could provide new insights into statistical processes such as photosynthesis, and help to accelerate search algorithms.

An experiment with a Galton board -- a board containing vertical pins arranged in a triangular pattern -- can demonstrate what a human would experience when wandering through a town on a path determined by chance. When a ball rolls over the board and strikes a pin positioned at a corner of the triangle, its path through the labyrinth of pins is determined by chance until it arrives at the triangle's base: At every step it takes through the labyrinth it is deflected by a pin to either the left or the right. Since it takes each of the two directions an equal number of times on average, it usually arrives in the centre of the base. Wandering through a labyrinth of streets, chance would similarly bring us to the centre of a town.

A particle with quantum properties would experience something different, as the researchers from the Max Planck Institute for the Science of Light in Erlangen and the Universities of Prague and Edinburgh have now proven. It would not have to decide on a direction at every pin, rather it would take the two possible paths at the same time, as this type of particle also possesses the properties of waves, and waves can do this. The particle's physical state is therefore then characterized by the fact that it contains all possible positions, i.e. all paths overlap. If the quantum particle finally leaves the labyrinth at the triangle's base, it is not unambiguously at one gap between two pins but at several -- an interference pattern is formed. And its properties include the fact that its intensity at the edges increases in proportion to the number of pins the wave-like particle has passed.

"Light is particularly suitable for experimentally investigating this type of random motion of a quantum particle," says Christine Silberhorn, whose working group carried out the experiment. Silberhorn and her colleagues are working with individual photons to this effect. The light particles produce classic examples of hermaphrodites of particles and waves. The physicists send the individual photons through an experimental set-up that represents a Galton board in principle, yet operates in a completely different way in practice. In this case, it is not chance that decides on the direction which a photon takes at each step, but its polarization, meaning the direction in which its light wave oscillates, therefore determining the photon's subsequent direction of motion.

The photon oscillating either horizontally or vertically corresponds to the classical ball on a Galton board deciding which direction to take. The physicists are therefore much more interested in the case where the photon assumes an overlapping state comprising both oscillation directions. They create this state by using a polarizer to first generate a photon oscillating in a horizontal or vertical direction.

This is then moved to the superimposed state by means of a half-wave plate. The half-wave plate acts, to a certain extent, like the pin of a classical Galton board, except that it does not force the photon to adopt a specific direction but ensures that it figuratively continues to move in both directions.

They then separate the photon in this hermaphroditic state into its two halves -- one oscillating in a vertical and one in a horizontal direction -- and guide them separately through two glass fibre cables. The two halves still form a single photon, however -- something which is only possible in the quantum world. The half oscillating in the vertical direction now has to cover a much longer path before the physicists recombine the paths of the two photon halves.

The split photon then moves in the form of two wave packets wandering one behind the other through a glass fibre -- it has therefore then completed the first step on the Galton board. For the second step, the glass fibre guides the two photon halves back to the half-wave plate, which converts each half back into a hermaphrodite again. And the whole procedure begins anew.

The physicists allowed the photon to pass through the loop five times. They then found that one of the photons had fanned out into a chain of several wave packets which formed a superimposed state. The packets at the edge of the chain were much stronger. According to the laws of quantum physics, this means: When the researchers guide the fanned-out photon to a detector that only registers the photon as a particle, it measures it rather at the beginning or the end of the chain.

"Many of our colleagues did not believe that our experiment would be successful," says Katiuscia Cassemiro, who designed the experiment in collaboration with Christine Silberhorn. After all, superimposed states are very sensitive, even the smallest perturbations can cause it to collapse to a state with classical properties. "

We managed to achieve the crucial step, which avoids this, by spreading the photon's propagation time instead of that of its location, which is what happens on a Galton board," says Christine Silberhorn: This greatly simplified the experimental set-up, as a spatially separated photon would have to pass through a large number of optical instruments, all absolutely precisely matched to each other, which is almost impossible. The Erlangen-based physicists hope that they can also shield the photon in their experiment from any possible interference for more than five steps: "We want to expand the experiment to up to 20 steps by optimizing the individual components," says Katiuscia Cassemiro.

The experiments being conducted by the Erlangen physicists are not about board games in the quantum world, of course. They are primarily interested in the superposition state: whereas we humans have to put up with our classical existence, such quantum states do occur in biology, for example, in photosynthesis in plants: Only recently, researchers have established that molecules transport the energy of the sunlight they absorb through parts of the photosynthesis mechanism in the form of such a hermaphroditic state.

"We still do not know the precise effect that the quantum physical character of the transport has on the process," says Christine Silberhorn. "We can investigate such effects with our set-up because we can very accurately control the superposition state via the half-wave plate." The researchers can use the setting of this instrument to investigate the transition between quantum mechanical and classical behaviour, for example, which is also what happens with photosynthesis, in the final analysis.

In the distant future, the quantum mechanical random walk could also find practical application one day, as it is suitable, in principle, as a search function for a quantum computer. It would be possible to search a database or the Internet much more quickly with photons or electrons, which can move along many paths at the same time, than with classical particles, which have to cover all of the paths, one after the other. Theoretical physicists are still trying to work out the specifics of how this type of search algorithm could operate.

Story Source:

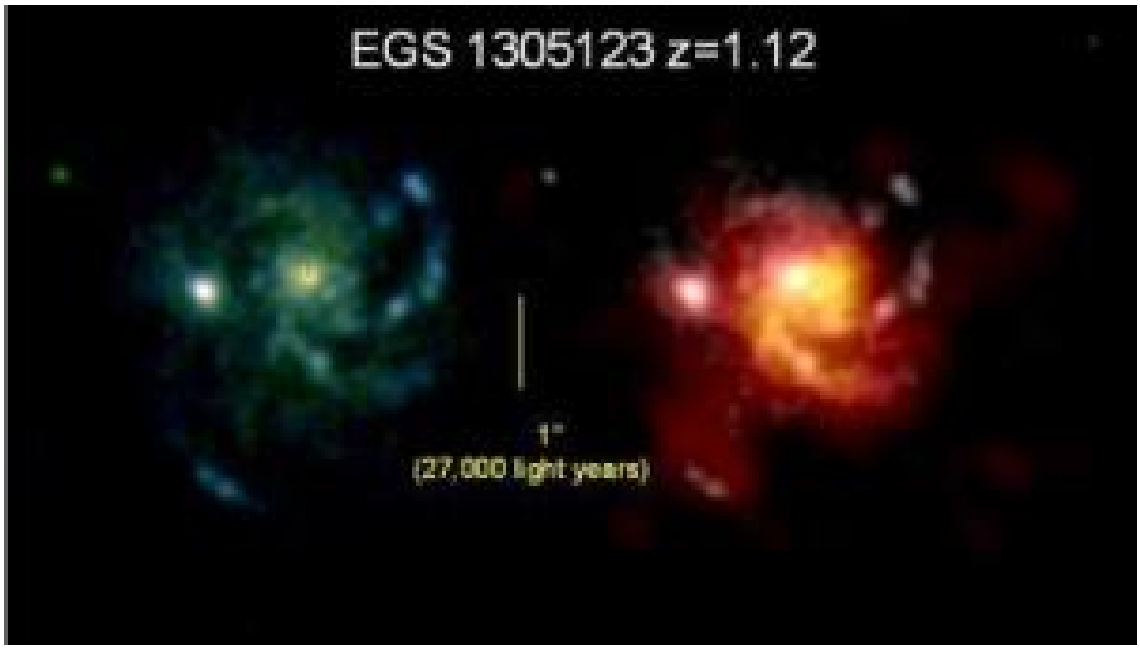
Adapted from materials provided by Max-Planck-Gesellschaft.

Journal Reference:

1. Schreiber et al. **Photons Walking the Line: A Quantum Walk with Adjustable Coin Operations**. *Physical Review Letters*, 2010; 104 (5): 050502 DOI: 10.1103/PhysRevLett.104.050502

http://www.sciencedaily.com/releases/2010/02/100216113555.htm

Why Today's Galaxies Don't Make as Many Stars as They Used to



Viewed through the Hubble Space Telescope at visible light (left), a galaxy does not reveal its full secret underlying star formation. Only when observed using a combination of radio emission and infrared wavelengths, the galaxy reveals a massive, rotating disc measuring about 60,000 light years across (right). This disc consists of cold molecular gas and dust, the raw materials from which stars are born. (Credit: M. Cooper/University of Arizona)

ScienceDaily (Feb. 17, 2010) — University of Arizona astronomers have helped solve a mystery surrounding the birth of stars in galaxies that has long puzzled scientists. Their results are published in the Feb. 11 issue of *Nature*.

"We have known for more than a decade that in the early universe -- three to five billion years after the Big Bang or nine to eleven billion years before today -- galaxies churned out new stars at a much faster rate than they do now," said Michael Cooper, a postdoctoral Spitzer fellow at the UA's Steward Observatory.

"What we haven't known is whether this was because they somehow formed stars more efficiently or because more raw material -- molecular gas and dust -- was available," said his colleague Benjamin Weiner, an assistant astronomer at Steward Observatory and one of the co-authors on the paper.

Compared to the average galaxy today, which produces stars at rates equaling about 10 times the mass of our sun per year, the rate of star formation in those same galaxies appears to have been up to 10 times higher when they were younger.

In its efforts to find an answer, the scientific community has tended to turn telescopes toward few, rare, very bright objects, mostly because the instruments available did not allow for the study of less extreme, more typical galaxies. By focusing on the rare, bright objects, the results obtained cast doubts as to whether they are true for the majority of galaxies populating the universe.

"It is a little bit like studying only individuals who are seven feet tall instead of looking at those who fall in a more common range of body height," said Cooper.

He and his coworkers took advantage of more sensitive instruments and refined surveying methods to hone in on more than a dozen 'normal' galaxies. "Our study is the first to look at the 'five-foot eight' kinds of galaxies, if you will," Copper said. "Our results therefore are more representative of the typical galaxy out there. For the first time, we are getting a much more complete picture of how galaxies make stars."

New stars form from vast swaths of cold gas and dust that make up large parts of a galaxy. Because the star-forming raw material is not easily detected and data on its distribution are sparse and difficult to obtain, researchers until now had trouble knowing which of the following two scenarios is true: Do typical galaxies still hold sufficient quantities of the ingredients required for star formation, but for some reason their efficiency of making stars has slowed down over cosmic time? Or, do present-day galaxies form fewer stars than they did in the past simply because they have used up most of their gas and dust supplies in the process?

To answer such questions, astronomers have to look not only far out into space, but also far back in time. To do that, they take advantage of a phenomenon known as the Doppler effect.

The Doppler effect is apparent to a motorist waiting at a traffic light when the sound of an oncoming ambulance changes to a slightly lower pitch as it passes through the intersection. This happens because the ambulance truck's speed adds to the speed of the sound waves produced by its siren. As the vehicle passes and moves away, the sound waves take slightly longer to reach the observer's ears.

Because the universe is expanding, galaxies behave a bit like cosmic ambulance trucks: As they move farther away from an observer based here on earth, the light they emit shifts to a slightly lower frequency toward the red in the light spectrum.

Astronomers use this red shift to determine the speed with which a galaxy is receding from earth, allowing them to calculate its distance.

In the vastness of the universe, distance equals time: The light we see from a galaxy that is, say, five billion light years away, has been traveling through space for five billion years before it hit the lens of our telescope. Therefore, the galaxy we observe today actually represents that galaxy five billion years in the past.

Cooper and his colleagues used data from an earlier study, in which they had surveyed about 50,000 galaxies, to pick a sample representing an 'average' population of galaxies. They then pointed various telescopes, among them the Hubble and the Spitzer space telescopes and radio telescope arrays in France and California, toward their study objects.

"By observing those galaxies in the infrared spectrum and measuring their radio frequency emissions, we were able to make their cold gas clouds visible," explained Cooper.

"What we found now is that galaxies like the ancestors of the Milky Way had a much greater supply of gas than the Milky Way does today," said Weiner. "Thus, they have been making stars according to the same laws of physics, but more of them in a given time because they had a greater supply of material."

The research team also obtained images revealing the extent of the star-forming material that permeates galaxies. In one image of a typical galaxy named EGS 1305123, seen as it was a mere 5.5 billion years after the Big Bang, the scientist's observations for the first time show a massive, rotating disc measuring about 60,000 light years across.

The disc, made up of cold gas and dust, is similar in size and structure to that in a typical galaxy, such as our own, the Milky Way, and gives an impression of what it would have looked like at the time, eight and a half billion years ago.

"From our study, we now know that typical galaxies in the early universe contained three to ten times more molecular gas than today," said Cooper, "a strong indication that the rate of star formation has slowed because those galaxies have less raw material available compared to when they were younger, and not because there was some change in efficiency with which they make new stars."

Cooper and Weiner have led the U.S. portion of this large undertaking, which is headed by scientists from the Max-Planck-Institute for Extraterrestrial Physics in Garching, Germany.

Story Source:

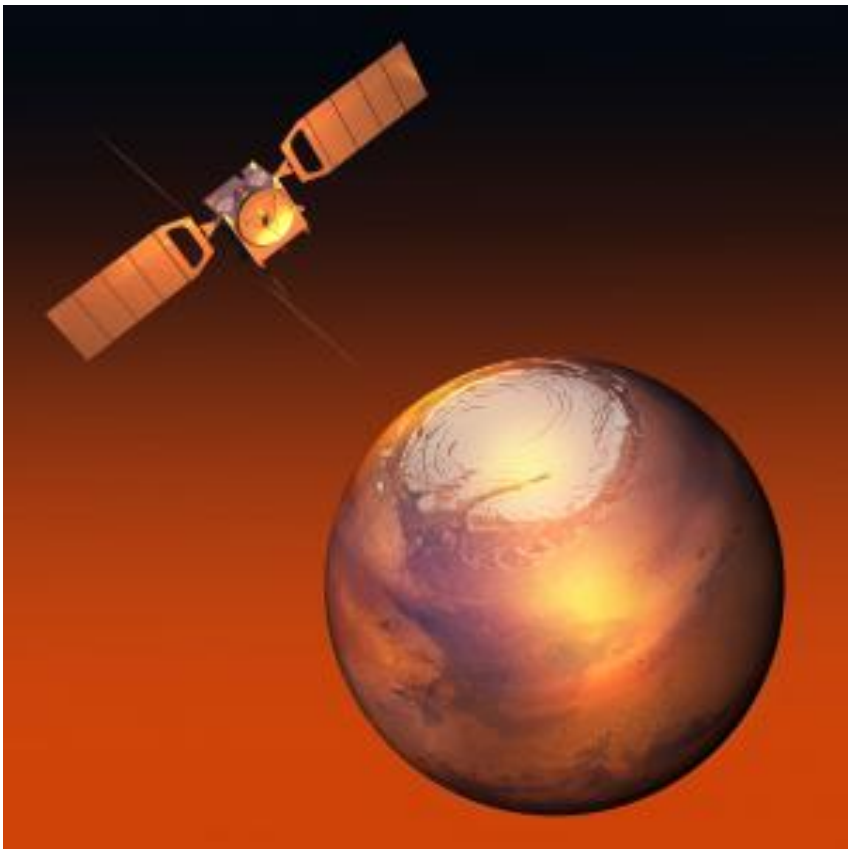
Adapted from materials provided by University of Arizona, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Tacconi et al. **High molecular gas fractions in normal massive star-forming galaxies in the young Universe**. *Nature*, 2010; 463 (7282): 781 DOI: 10.1038/nature08773

http://www.sciencedaily.com/releases/2010/02/100216101201.htm

Phobos Flyby Season Starts Again



Artists impression of Mars Express in its polar orbit. (Credit: ESA)

ScienceDaily (Feb. 17, 2010) — Mars Express has just began a series of flybys of Phobos, the largest moon of Mars. The campaign will reach its crescendo on 3 March, when the spacecraft will set a new record for the closest pass to Phobos, skimming the surface at just 50 km. The data collected could help untangle the origin of this mysterious moon.

The latest Phobos flyby campaign began February 16 at 06:52 CET (05:52 UT), when Mars Express drew to within 991 km of Phobos' airless surface. The flybys will continue at varying altitudes until 26 March when Phobos moves out of range. They offer prime chances for doing additional science with Mars Express, a spacecraft that was designed to study the red planet below rather than the grey moon alongside.

"Because Mars Express is in an elliptical and polar orbit with a maximum distance from Mars of about 10 000 km, we regularly pass Phobos. This represents an excellent opportunity to perform extra science," says Olivier Witasse, Mars Express Project Scientist.

Back in 2009, the mission team decided that the orbit of Mars Express needed to be adjusted to prevent the closest approach of the spacecraft drifting onto the planet's nightside. The flight control team at the European Space Operations Centre in Darmstadt, Germany, presented a number of possible scenarios, including one that would take the spacecraft to just 50 km above Phobos. "That was the closest they would let us fly to Phobos," says Witasse.

Precise gravity measurements

Heavy emphasis is being placed upon the closest flyby because it is an unprecedented opportunity to map Phobos' gravity field. At that range, Mars Express should feel differences in the pull from Phobos depending which part of the moon is closest at the time. This will allow scientists to infer the moon's internal structure.

Previous Mars Express flybys have already provided the most accurate mass yet for Phobos, and the High Resolution Stereo Camera (HRSC) has provided the volume. When calculating the density, this gives a surprising because it seems that parts of Phobos may be hollow. The science team aim to verify this preliminary conclusion.

In particular, the MARSIS radar will operate in a special sequence to try to see inside the moon, looking for structures or some clue to the internal composition. "If we know more about how Phobos is built, we might know more about how it formed," says Witasse.

The origin of Phobos is a mystery. Three scenarios are possible. The first is that the moon is a captured asteroid. The second is that it formed in situ as Mars formed below it. The third is that Phobos formed later than Mars, out of debris flung into Martian orbit when a large meteorite struck the red planet.

All the instruments will be used during the campaign, including HRSC. Although no imaging will be possible during the first five flybys, including the closest one, because Mars Express approaches from the nightside, high-resolution pictures will be possible from 7 March onwards. One task for HRSC is to image the proposed landing sites for the Russian mission Phobos-Grunt.

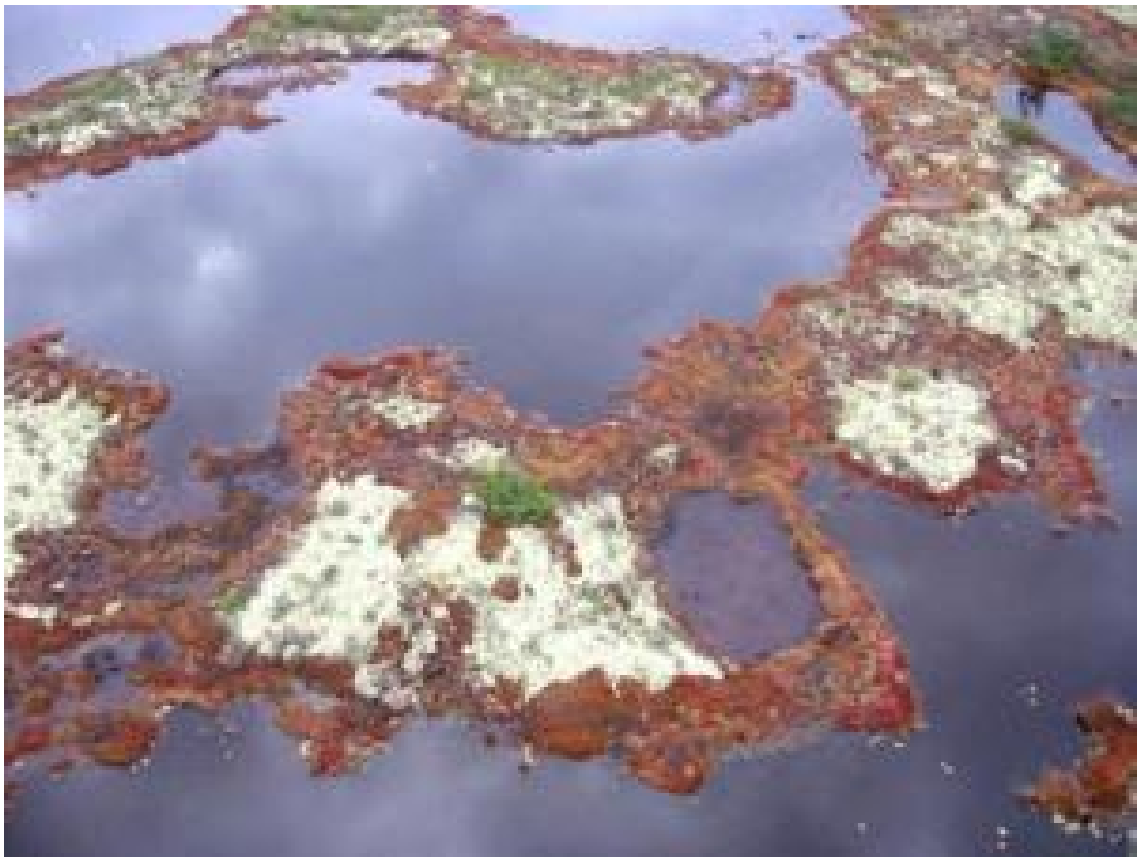
"It is always busy," says Witasse about running the science mission. "The Phobos flybys make it even more exciting."

Story Source:

Adapted from materials provided by European Space Agency.

http://www.sciencedaily.com/releases/2010/02/100216113851.htm

Permafrost Line Recedes 130 Km in 50 Years, Canadian Study Finds



Pictured are lichen and shrub--covered palsas surrounded by a pond resulting from melting permafrost in a bog near the village of Radisson, Canada. (Credit: Serge Payette)

ScienceDaily (Feb. 17, 2010) — The southern limit of permanently frozen ground, or permafrost, is now 130 kilometers further north than it was 50 years ago in the James Bay region, according to two researchers from the Department of Biology at Université Laval.

In a recent issue of the scientific journal *Permafrost and Periglacial Processes*, Serge Payette and Simon Thibault suggest that, if the trend continues, permafrost in the region will completely disappear in the near future.

The researchers measured the retreat of the permafrost border by observing hummocks known as "palsas," which form naturally over ice contained in the soil of northern peat bogs. Conditions in these mounds are conducive to the development of distinct vegetation -- lichen, shrubs, and black spruce -- that make them easy to spot in the field.

In an initial survey in 2004, the researchers examined seven bogs located between the 51st and 53rd parallels. They noted at that time that only two of the bogs contained palsas, whereas aerial photos taken in 1957 showed palsas present in all of the bogs. A second assessment in 2005 revealed that the number of palsas present in these two bogs had decreased over the course of one year by 86% and 90% respectively.

Helicopter flyovers between the 51st and 55th parallels also revealed that the palsas are in an advanced state of deterioration over the entire James Bay area.

While climate change is the most probable explanation for this phenomenon, the lack of long term climatic data for the area makes it impossible for the researchers to officially confirm this. Professor Payette notes, however, that the average annual temperature of the northern sites he has studied for over 20 years has increased by 2 degrees Celsius.

"If this trend keeps up, what is left of the palsas in the James Bay bogs will disappear altogether in the near future, and it is likely that the permafrost will suffer the same fate," concludes the researcher affiliated to the Centre d'études nordiques.

Story Source:

Adapted from materials provided by Université Laval, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Simon Thibault, Serge Payette. **Recent permafrost degradation in bogs of the James Bay area, northern Quebec, Canada**. *Permafrost and Periglacial Processes*, 2009; 20 (4): 383 DOI: 10.1002/ppp.660

http://www.sciencedaily.com/releases/2010/02/100217101129.htm

Later Introduction of Baby Foods Related to Lower Risk of Obesity Later in Life

A baby eating baby food. A late introduction of baby food, rather than duration of breastfeeding, may protect against becoming overweight in adulthood. (Credit: iStockphoto)

ScienceDaily (Feb. 17, 2010) — Benjamin Franklin's advice that "an ounce of prevention is worth a pound of cure" can easily be applied to today's most pressing health issue: obesity. Because taking off extra weight is an almost insurmountable challenge, preventing the progression of weight gain throughout life, especially childhood, is crucial to realizing optimal long-term health.

One area of great interest is the possibility that being breastfed might predispose a person to being lean, and the longer the better. Extended breastfeeding, however, is usually associated with delayed introduction of complementary "baby" foods, and it is possible that this (gain rather than breastfeeding) might influence weight.

To investigate this possibility, a team of Danish researchers led by Kim Fleischer Michaelsen investigated these factors in a group of individuals who were studied from birth until adulthood. Their findings, and an accompanying editorial by Michael Kramer, are published in the March 2010 issue of The *American Journal of Clinical Nutrition.*

Neither breastfeeding duration nor timing of complementary foods was related significantly to BMI in childhood, adolescence, or early adulthood. However, at 42 y of age the risk of being overweight decreased with increasing age at introduction of complementary foods. For instance, for each month introduction of vegetables was delayed, the risk of being overweight at 42 y of age was reduced by 10%.

ASN Spokesperson Shelley McGuire, PhD, highlights that "As parents, we all want to know what we can do to help our children avoid obesity, so research like the study led by Dr. Fleishcher Michaelsen is extremely important- it provides evidence that breastfeeding per se may not have an effect on body weight; instead, it may be other feeding choices (like when baby foods are introduced) that are related to breastfeeding choices. Most likely, these factors work together to prevent or predispose a growing child to obesity later in life."

Story Source:

Adapted from materials provided by American Society for Nutrition, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Schack-Nielsen et al. **Late introduction of complementary feeding, rather than duration of breastfeeding, may protect against adult overweight**. *American Journal of Clinical Nutrition*, 2009; DOI: 10.3945/ajcn.2008.27078

http://www.sciencedaily.com/releases/2010/02/100216142336.htm

Migraine More Common in Women With Multiple Sclerosis

ScienceDaily (Feb. 17, 2010) — Migraine is seen more frequently in women with multiple sclerosis (MS) than those without, according to a study that will be presented at the American Academy of Neurology's 62nd Annual Meeting in Toronto April 10 to April 17, 2010.

"While having a history of migraine diagnosis was linked to MS, women with migraine need to know that over 99 percent of them will never develop MS, thus having migraine should definitely not be a reason to worry about getting MS," said study author Ilya Kister, MD, with New York University School of Medicine and a member of the American Academy of Neurology. "More research is needed since it's still not known whether migraine is a risk factor for developing MS or if it is a condition that occurs at the same time as MS."

The study involved 116,678 women who were part of the Nurses' Health Study II. Of these women, 18,000 had been diagnosed with migraine at the start of the study. The women were followed every two years for 16 years. During the study, 375 women were diagnosed with MS. Of those, 82 had reported at the beginning of the study that they had been diagnosed by a doctor with migraine.

The study found that women with a migraine diagnosis at the beginning of the study were 47 percent more likely to develop MS than women without a diagnosis. The results were the same regardless of age, where they lived, Scandinavian ancestry, vitamin D levels, smoking status and body mass index.

The research represents the first large scale study of its kind to explore the relationship between migraine and MS.

More data on this relationship will be presented by Kister at the American Academy of Neurology Annual Meeting in Toronto.

Story Source:

Adapted from materials provided by American Academy of Neurology.

http://www.sciencedaily.com/releases/2010/02/100216163324.htm

The Carbon Cycle Before Humans: New Studies Provide Clearer Picture of How Carbon Cycle Was Dramatically Affected Long Ago

ScienceDaily (Feb. 17, 2010) — Geoengineering -- deliberate manipulation of the Earth's climate to slow or reverse global warming -- has gained a foothold in the climate change discussion. But before effective action can be taken, the Earth's natural biogeochemical cycles must be better understood.

Two Northwestern University studies, both published online recently by *Nature Geoscience*, contribute new -- and related -- clues as to what drove large-scale changes to the carbon cycle nearly 100 million years ago. Both research teams conclude that a massive amount of volcanic activity introduced carbon dioxide and sulfur into the atmosphere, which in turn had a significant impact on the carbon cycle, oxygen levels in the oceans and marine plants and animals.

Both teams studied organic carbon-rich sediments from the Western Interior Seaway, an ancient seabed stretching from the Gulf of Mexico to the Arctic Ocean, to learn more about a devastating event 94.5 million years ago when oxygen levels in the oceans dropped so low that one-third of marine life died.

The authors of the first paper, titled "Volcanic triggering of a biogeochemical cascade during Oceanic Anoxic Event 2," reveal that before oxygen levels dropped so precipitously there was a massive increase in oceanic sulfate levels. Their conclusion is based on analyses of the stable isotopes of sulfur in sedimentary minerals from the central basin of the Western Interior Seaway, located in Colorado.

The researchers theorize that a massive amount of volcanic activity caused this sulfate spike, which triggered a cascade of biogeochemical events. More sulfate led to an abundance of the nutrient phosphorous, which allowed phytoplankton populations in the oceans to multiply. The phytoplankton thrived and then died. Their decomposing bodies depleted oxygen levels in the oceans, leading to the widespread death of marine animals.

The sedimentary burial of marine organic carbon during this event was so large, some prior studies hypothesized that it caused a decrease in atmospheric carbon dioxide levels. In the second *Nature Geoscience* paper, titled "Carbon sequestration activated by a volcanic carbon dioxide pulse during ocean anoxic event 2," the researchers tested the carbon dioxide drawdown prediction. By studying fossil plant cuticle material, they determined the amount of carbon dioxide in the atmosphere at the time the plants were growing. (The cuticle samples were collected from sites representing the western shore of the Western Interior Seaway, in present-day southwestern Utah.)

This work found that before the onset of ocean anoxia, the level of carbon dioxide in the atmosphere increased by approximately 20 percent. This significant increase is consistent with the volcanic activity invoked by the first Northwestern study (described above). The paleo-carbon dioxide reconstruction also detected two episodes of marked decrease in carbon dioxide levels -- up to 200 parts per million -- at the time of the early phase of marine carbon burial. This observation provides strong support for the carbon dioxide drawdown hypothesis.

"Our research highlights the previously unappreciated role that the sulfur cycle plays in regulating nutrient cycling, the carbon cycle and climate," said Matthew Hurtgen, assistant professor of Earth and planetary sciences in the Weinberg College of Arts and Sciences at Northwestern and lead researcher of the first study.

"These two complementary studies provide a much clearer picture of how the Earth's carbon cycle was dramatically affected by catastrophic natural events long ago," said Bradley Sageman, professor and chair of Earth and planetary sciences at Northwestern and a co-author of both papers. "Although these events played out over hundreds or thousands of years, the magnitude of the changes, in carbon dioxide levels for example, are similar to those of the last 150 years resulting from human influence on the carbon cycle. The evidence demonstrates that the modern carbon cycle has been accelerated by orders of magnitude."

The sulfur work reported in the paper "Volcanic triggering of a biogeochemical cascade during Oceanic Anoxic Event 2" was conducted by Derek D. Adams, a doctoral candidate in Hurtgen's research group. Adams is first author of the paper; Hurtgen and Sageman are the paper's other authors.

Richard S. Barclay, a doctoral candidate in Sageman's research group, is the first author of the "Carbon sequestration activated by a volcanic carbon dioxide pulse during ocean anoxic event 2" paper. Sageman also is an author, and the third author is Jennifer McElwain, a professor from University College Dublin who co-advises Barclay's research and is one of the originators of the cuticle analysis method.

Story Source:

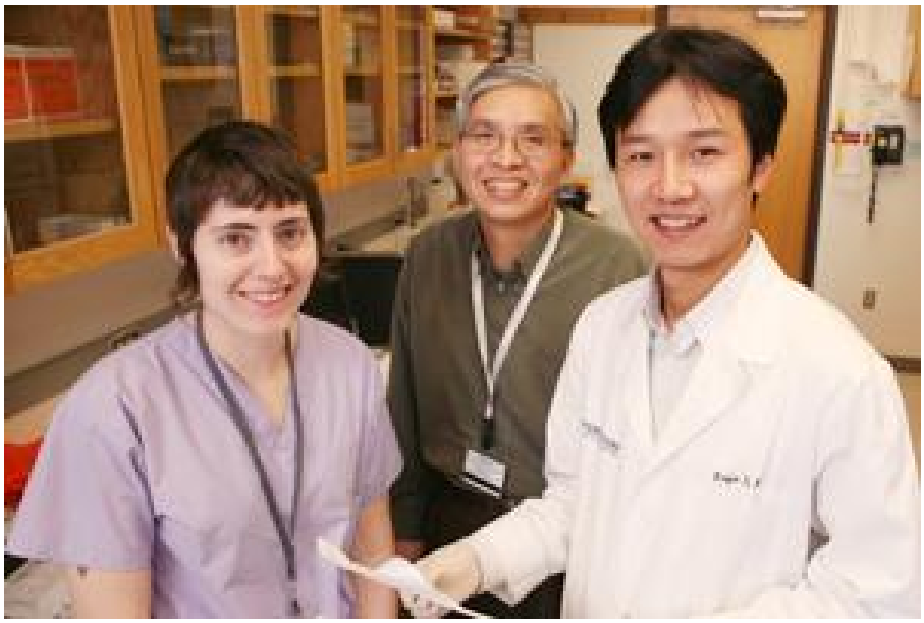
Adapted from materials provided by Northwestern University, via EurekAlert!, a service of AAAS.

Journal References:

1. Derek D. Adams, Matthew T. Hurtgen & Bradley B. Sageman. **Volcanic triggering of a biogeochemical cascade during Oceanic Anoxic Event 2**. *Nature Geoscience*, 2010; DOI: 10.1038/ngeo743
2. Richard S. Barclay, Jennifer C. Mcelwain & Bradley B. Sageman. **Carbon sequestration activated by a volcanic CO_2 pulse during Ocean Anoxic Event 2**. *Nature Geoscience*, 2010; DOI: 10.1038/ngeo757

http://www.sciencedaily.com/releases/2010/02/100216163525.htm

Loss of Gene Function Makes Prostate Cancer Cells More Aggressive



UT Southwestern researchers, including Crystal Gore, Dr. Jer-Tsong Hsieh (center) and Dr. Daxing Xie, have shown that prostate cancer cells are more likely to spread to other parts of the body if a specific gene quits functioning normally. (Credit: Image courtesy of UT Southwestern Medical Center)

ScienceDaily (Feb. 17, 2010) — Prostate cancer cells are more likely to spread to other parts of the body if a specific gene quits functioning normally, according to new data from researchers at UT Southwestern Medical Center.

Certain prostate cancer cells can be held in check by the *DAB2IP* gene. The gene's product, the DABIP protein, acts as scaffolding that prevents many other proteins involved in the progression of prostate cancer cells from over-activation. When those cells lose the DAB2IP protein, however, they break free and are able to metastasize, or spread, drastically increasing the risk of cancer progression in other organs as the cells travel through the bloodstream or lymph system.

The study in mice, published in the Jan. 11 issue of the *Proceedings of the National Academy of Sciences*, found that eliminating the DAB2IP scaffolding in human carcinoma cells caused them to change from epithelial cells to mesenchymal cells -- a hallmark of metastatic cancer.

Cells undergoing an epithelial to mesenchymal transition (EMT) experience biological changes that enable them to move freely and spontaneously throughout the body," said Dr. Jer-Tsong Hsieh, director of the Jean H. & John T. Walker Jr. Center for Research in Urologic Oncology at UT Southwestern and the study's senior author. "By restoring DAB2IP function in cancer cells in mice, we reversed their ability to change and metastasize."

Dr. Hsieh said identifying the DAB2IP protein in human cells might serve as a biomarker, helping physicians identify patients who could have more aggressive, metastatic forms of prostate cancer.

EMT is known to play an important role in embryo implantation, embryogenesis and organ development, and tissue regeneration, as well as in cancer progression and metastasis. For cancer progression, EMT is believed to facilitate the migratory and invasive ability of cancer cells.

"Carcinoma cells undergo several changes that enable them to spread," said Dr. Hsieh, also professor of urology. "The majority of human visceral tumors derived from carcinomas are primarily made up of

epithelial cells. When they acquire mesenchymal phenotypes, they lose cell-to-cell adhesion and become more mobile throughout the body."

In the current study, Dr. Hsieh and his team first shut down the *DAB2IP* gene expression in prostate epithelial cells in mice and found that the prostate cancers did indeed metastasize to lymph nodes and other organs in mice. When the researchers restored the *DAB2IP* genetic function to metastatic prostate cancer cells, the EMT process reversed, thereby inhibiting the cancer cells' ability to spread.

"Based on the outcome of this paper, we believe the assessment of DAB2IP in these cancer cells can be a valuable prognostic biomarker for risk of the aggressiveness of certain prostate cancers," said Dr. Daxing Xie, urology postdoctoral researcher and lead author of the study. "Further understanding of the DAB2IP function could also provide potential therapeutic strategies for treating prostate cancer."

Other UT Southwestern researchers involved in this study were Crystal Gore and Michael Long, research technicians; Dr. Jun Liu, postdoctoral researcher; Rey-Chen Pong, senior research associate; Dr. Ralph Mason, professor of radiology; Dr. Guiyang Hao, postdoctoral researcher; Dr. Wareef Kabbani, assistant professor of pathology; Dr. Xiankai Sun, assistant professor of radiology in the Advanced Imaging Research Center; and Dr. David Boothman, professor of radiation oncology and pharmacology and associate director of translational research in the Harold C. Simmons Comprehensive Cancer Center.

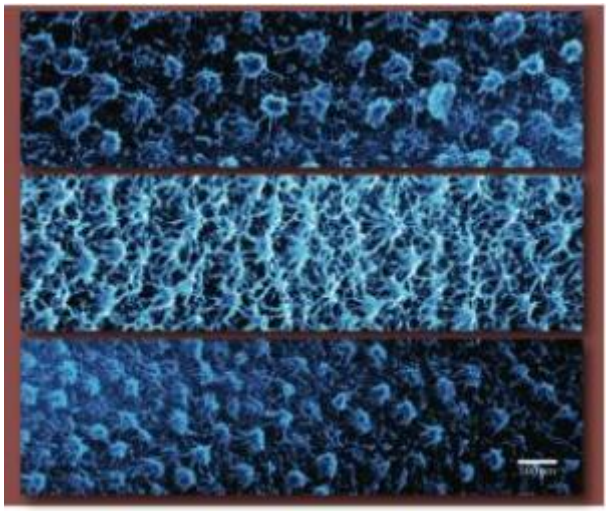
The study was supported by the U.S. Army, the National Institutes of Health and the Department of Energy.

Story Source:

Adapted from materials provided by UT Southwestern Medical Center.

http://www.sciencedaily.com/releases/2010/02/100202141306.htm

Attacking Cancer Cells With Hydrogel Nanoparticles



An artistic rendering of hydrogel nanoparticles. (Credit: Andrew Lyon)

ScienceDaily (Feb. 17, 2010) — One of the difficulties of fighting cancer is that drugs often hit other non-cancerous cells, causing patients to get sick. But what if researchers could sneak cancer-fighting particles into just the cancer cells? Researchers at the Georgia Institute of Technology and the Ovarian Cancer Institute are working on doing just that. In the online journal *BMC Cancer* they detail a method that uses hydrogels -- less than 100 nanometers in size -- to sneak a particular type of small interfering RNA(siRNA) into cancer cells. Once in the cell the siRNA turns on the programmed cell death the body uses to kill mutated cells and help traditional chemotherapy do it's job.

Many cancers are characterized by an over abundance of epidermal growth factor receptors (EGFR). When the EGFR level in a cell is elevated it tells the cell to replicate at a rapid rate. It also turns down apoptosis, or programmed cell death.

"With our technique we're inhibiting EGFR's growth, with small interfering RNA. And by inhibiting it's growth, we're increasing the cells's apoptotic function. If we hit the cell with chemotherapy at the same time, we should be able to kill the cancer cells more effectively," said John McDonald, professor at the School of Biology at Georgia Tech and chief research scientist at the Ovarian Cancer Institute.

Small interfering RNA is good at shutting down EGFR production, but once inside the cell siRNA has a limited life span. Keeping it protected inside the hydrogel nanoparticles allows them to get into the cancer cell safely and acts as a protective barrier around them. The hydrogel releases only a small amount of siRNA at a time, ensuring that while some are out in the cancer cell doing their job, reinforcements are held safely inside the nanoparticle until it's time to do their job.

"It's like a Trojan horse," said L. Andrew Lyon, professor in the School of Chemistry and Biochemistry at Georgia Tech. "We've decorated the surface of these hydrogels with a ligand that tricks the cancer cell into taking it up. Once inside, the particles have a slow release profile that leaks out the siRNA over a timescale of days, allowing it to have a therapeutic effect."

Cells use the messenger RNA (mRNA) to generate proteins, which help to keep the cell growing. Once the siRNA enters the cell, it binds to the mRNA and recruits proteins that attack the siRNA-mRNA complex. But the cancer cell's not finished; it keeps generating proteins, so without a continuous supply of siRNA, the cell recovers. Using the hydrogel to slowly release the siRNA allows it to keep up a sustained attack so that it can continue to interrupt the production of proteins.

"We've shown that you can get knock down out to a few days time frame, which could present a clinical window to come in and do multiple treatments in a combination chemotherapy approach," said Lyon.

"The fact that this system is releasing the siRNA slowly, without giving the cell time to immediately recover, gives us much better efficiency at killing the cancer cells with chemotherapy," added McDonald.

Previous techniques have involved using antibodies to knock down the proteins.

"But oftentimes, a mutation may arise in the targeted gene such that the antibody will no longer have the effect it once did, thereby increasing the chance for recurrence," said McDonald.

The team used hydrogels because they're non-toxic, have a relatively slow release rate, and can survive in the body long enough to reach their target.

"It's a well-defined architecture that you're using the intrinsic porosity of that material to load things into, and since our particles are about 98 percent water by volume, there's plenty of internal volume in which to load things," said Lyon.

Currently, the tests have been shown to work *in vitro*, but the team will be initiating tests *in vivo* shortly.

Story Source:

Adapted from materials provided by Georgia Institute of Technology.

http://www.sciencedaily.com/releases/2010/02/100216140404.htm

What the Brain Values May Not Be What It Buys

ScienceDaily (Feb. 17, 2010) — It's no wonder attractive human faces are everywhere in media and advertising -- when we see those faces, our brains are constantly computing how much the experiences are worth to us. New brain-imaging research shows it's even possible to predict how much people might be willing to pay for a particular face.

Researchers at Duke University Medical Center found that as participants were watching a sequence of faces, their brains were simultaneously evaluating those faces in two distinct ways: for the quality of the viewing experience and for what they would trade to see the face again.

The work was published in the *Journal of Neuroscience* online on Feb. 16.

They showed college-aged men a parade of female faces, intermixed with images of money, while measuring brain activation using functional magnetic resonance imaging (fMRI). In a later experiment, the same participants could pay more or less money to view more or less attractive faces.

"One part of the frontal cortex of our participants' brains increased in activation to more attractive faces, as if it computed those faces' hedonic (quality of the experience) value," said senior author Scott Huettel, Ph.D., an associate professor of psychology & neuroscience who directs the Center for Neuroeconomic Studies at Duke. "A nearby brain region's activation also predicted those faces' economic value -- specifically, how much money that person would be willing to trade to see another face of similar attractiveness."

During the fMRI experiment, heterosexual men viewed a set of female faces that had previously been rated for attractiveness by peers. Interspersed with the face pictures were pictures of money, shown in several denominations, which indicated real monetary gains or losses that the participant could later spend during the next phase of the experiment. The participants made a series of economic decisions: Should they spend more of their money to see a more attractive face, or spend less money but see a less attractive face? Each participant made about one hundred of these decisions, spending from 1 to 12 cents each time.

The researchers measured fMRI activation while the participants viewed the faces and money. In a region near the front of the brain, the anterior ventromedial prefrontal cortex (VMPFC), there was increased activation when participants saw a more attractive face or saw a picture of a larger amount of money. That pattern of brain activation was relatively stable across participants in the study. Yet, slightly farther back in the brain, within posterior VMPFC, the researchers also could see the relative activation to the faces compared to money, which strongly predicted how each person would later spend to see a more attractive face.

Huettel said that findings from neuroscience might lead to new directions in marketing. "People often respond to images in a very idiosyncratic fashion," he said. "While we can't use neuroscience to identify the best images for every person's brain, we could identify types of images that tend to modulate the right sorts of value signals -- those that predict future purchases for a market segment."

Lead author David V. Smith, a graduate student in psychology & neuroscience, explained further: "Previous studies have shown that active decisions about the value of real goods, such as candy or consumer products, evoke activation in the VMPFC. Our study demonstrates that the VMPFC actually contains two signals for value: one that indicates how much value we are currently experiencing, and another that indicates how much we'd be willing to pay to have that experience again later."

Why were all subjects male? "For this new study, we built on prior work from colleagues who showed that young adult males not only value the experience of seeing a female face, but will treat that experience like an economic good -- they will trade experience for money in a predictable manner," Huettel said. "We expect that the functioning of the brain's reward system is essentially similar between males and

females. However, what sorts of stimuli seem attractive -- whether an image of a face or some other social cue -- may differ between the genders."

Smith added that they plan to continue the research with other kinds of rewards, including different types of pictures. "A key issue in future research will be examining how different value signals are communicated between different parts of the brain to produce our decisions," Smith said.

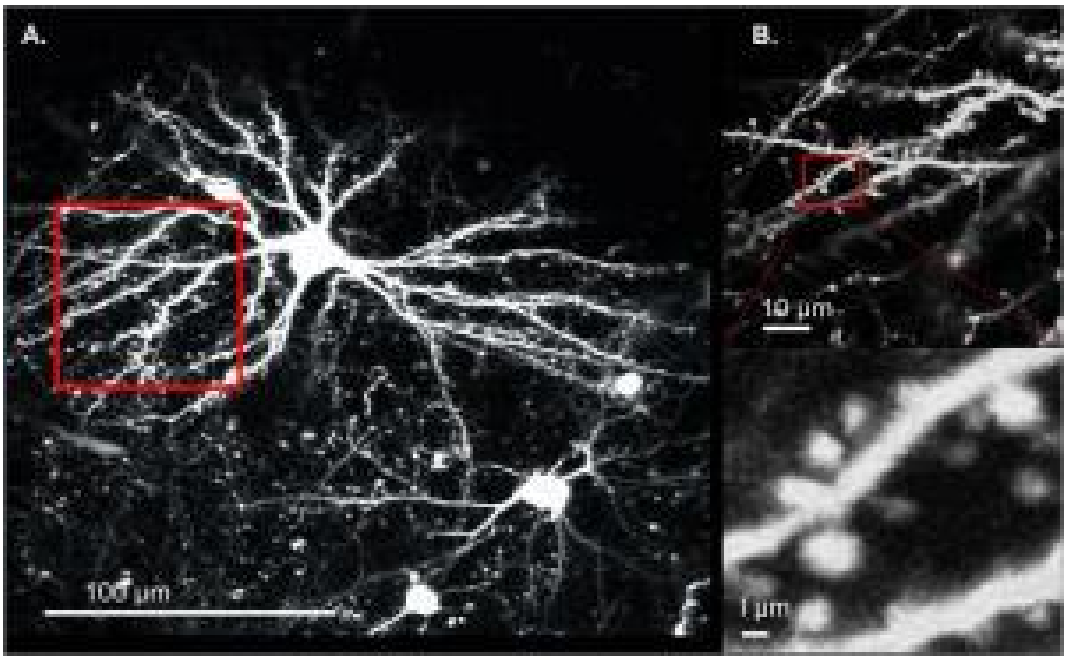
Other authors included Benjamin Hayden and Michael Platt of the Duke Department of Neurobiology and the Duke Center for Cognitive Neuroscience, and Trong-Kha Truong and Allen Song of the Duke Department of Radiology and the Brain Imaging and Analysis Center. The research was funded by grants from the National Institutes of Health (NIH).

Story Source:

Adapted from materials provided by Duke University Medical Center.

http://www.sciencedaily.com/releases/2010/02/100216182022.htm

Scientists Image Brain at Point When Vocal Learning Begins



High resolution in vivo images of neurons and associated dendritic spines in the brain of a juvenile songbird during the initial stages of song learning. Images taken by Todd Roberts. (Credit: Todd Roberts/Duke University Medical Center)

ScienceDaily (Feb. 19, 2010) — Duke University Medical Center scientists crowded around a laser-powered microscope in a darkened room to peer into the brain of an anesthetized juvenile songbird right after he heard an adult tutors' song for the first time.

Specifically, they wanted to see what happened to the connections between nerve cells, or synapses, in a part of the brain where the motor commands for song are thought to originate.

In the first experiment of its kind, they employed high resolution imaging to track changes to individual dendritic spines, important points of contact between nerve cells.

"We expected to see the building of new spines and loss of old spines accelerate when the juvenile heard a tutor's song for the first time," said senior author Richard Mooney, Ph.D., a Duke professor of neurobiology. "Instead, we saw exactly the opposite: hearing a tutor song rapidly stabilized previously dynamic synapses."

Juveniles with initially higher levels of spine turnover before hearing the tutor song subsequently learned more from their tutors. Because the scientists studied birds during their late adolescence, some may have been past their optimal learning period. "Juveniles in which spines were already highly stable weren't able to learn from their tutors," said Todd Roberts, Ph.D., a postdoctoral fellow in the Department of Neurobiology who is lead author on the study, which was published online in the journal *Nature* on Feb. 17.

In the "learners," hearing a tutor song rapidly stabilized spines.

Roberts said they were expecting to find higher "plasticity," the brain's ability to remodel connections in response to learning or injury. "We thought we would see an initial stage of higher plasticity, because it can take weeks or even months for a juvenile to copy the tutor song." .

The findings provide fundamental insight into how the brain changes during the juvenile's critical periods for behavioral learning. They also can guide future research aimed at restoring plasticity to synapses after the critical period closes, an important therapeutic goal in helping people regain function after an injury like hearing loss or stroke, Mooney said.

The researchers studied juvenile male songbirds that were kept only with females, which do not sing. They had been exposed to other calls and noises, but not the critically important song of a male tutor. "The adult male's song is a signal that the juvenile's brain seems to crave," Mooney said.

As to why this rapid stabilization of dendritic spines might be important, Mooney said that the songbird brain, like people's brains, is learning for an important goal, which is to perform a highly precise skill. "Many skills, including communication skills, require great precision if you want to stay in the gene pool," Mooney said. "A male songbird has to learn to sing precisely or he won't attract a mate."

The finding that a stable network of synapses rapidly forms after a young bird hears the tutor song suggests that an experience can act in a young brain to build stable connections between neurons, providing a foundation for learning new behaviors, like singing or speaking.

Roberts detailed the painstaking way that he and colleagues set up the experiment and imaged the individual dendritic spines. They used an engineered virus to infect certain nerve cells, which then expressed green fluorescent protein. "Hit with the right wavelength of light from a powerful and concentrated laser beam, the neuron glows and we can even see its dendritic spines, which are tiny components of excitatory synapses," Roberts said. The same neurons and spines were tracked and photographed for up to a month.

Co-authors included Katherine A. Tschida and Marguerita E. Klein of the Duke Department of Neurobiology. The study was funded by the National Science Foundation (NSF), the National Institutes of Health (NIH), a National Research Service Award from the NIH, an NSF pre-doctoral award and the Howard Hughes Medical Institute.

Story Source:

Adapted from materials provided by Duke University Medical Center.

Journal Reference:

1. Todd F. Roberts, Katherine A. Tschida, Marguerita E. Klein & Richard Mooney. **Rapid spine stabilization and synaptic enhancement at the onset of behavioural learning**. *Nature*, 2010; 463 (7283): 948 DOI: 10.1038/nature08759

http://www.sciencedaily.com/releases/2010/02/100217131128.htm

Projection Shows Water Woes Likely Based on Warmer Temperatures

Keith Cherkauer, an assistant professor of agricultural and biological engineering, surveys the Wabash River, one of many that could experience an increase in winter and spring flooding based on rising temperatures in the next century. (Credit: Purdue Agricultural Communication photo/Tom Campbell)

ScienceDaily (Feb. 19, 2010) — Several Midwestern states could be facing increased winter and spring flooding, as well as difficult growing conditions on farms, if average temperatures rise, according to a Purdue University researcher.

Keith Cherkauer, an assistant professor of agricultural and biological engineering, ran simulation models that show Indiana, Illinois, Wisconsin and Michigan could see as much as 28 percent more precipitation by the year 2070, with much of that coming in the winter and spring. His projections also show drier summer and fall seasons.

"This was already a difficult spring to plant because of how wet it was. If you were to add another inch or so of rain to that, it would be a problem," said Cherkauer, whose findings were published in the early online version of the *Journal of Great Lakes Research*. "It could make it difficult to get into fields. There's also a potential for more flooding."

Cherkauer used three different scenarios based on the amount of carbon that could be emitted into the atmosphere in the coming decades. Carbon calculations were based on assumptions including population, technological advancements, the economy and other factors.

Those scenarios were used in two climate projection models from the Intergovernmental Panel on Climate Change that give climate predictions from the years 1950 through 2099. Cherkauer said in years from 1950 to 2007 where actual climate data differed slightly from projections, the difference was subtracted to give a better projection for the future.

He calculated that winters in the four states could be between 2.7 degrees to 5.4 degrees Fahrenheit warmer by 2077 than today. Summers could be between 3.6 degrees and 10.8 degrees Fahrenheit warmer.

Those projections were then put into the Variable Infiltration Capacity Model -- which simulates how precipitation moves through land surface environments -- to predict stream flow for six rivers: the Chippewa River, Wisconsin River, Illinois River, Wabash River, Grand River and Rock River.

Cherkauer estimates that increased precipitation would result in about a 20 percent increase in peak and mean flows for the Wabash River, for instance.

Daily river flow would be lower during the summer and fall despite an expected increase in thunderstorms and heavy-rain events. Overall precipitation would be down in those seasons, he said, and heavy rains from time to time would still leave prolonged periods without precipitation.

"This area is not going to be short of water, but we may not have it at the right times," Cherkauer said. "We probably need to figure out how to store the excess water from the spring so we have it in the summer when we need it."

He said there are several possible avenues for storing spring water, from damming rivers to create reservoirs, to refilling aquifers that are pumped for water in the summer.

Cherkauer said next he wants to study how climate predictions would affect drought conditions, as well as how the projections on stream flow would impact aquatic life and ecology. NASA funded his research.

Cherkauer's work is affiliated with the Purdue Climate Change Research Center and the Center for the Environment in Discovery Park.

Story Source:

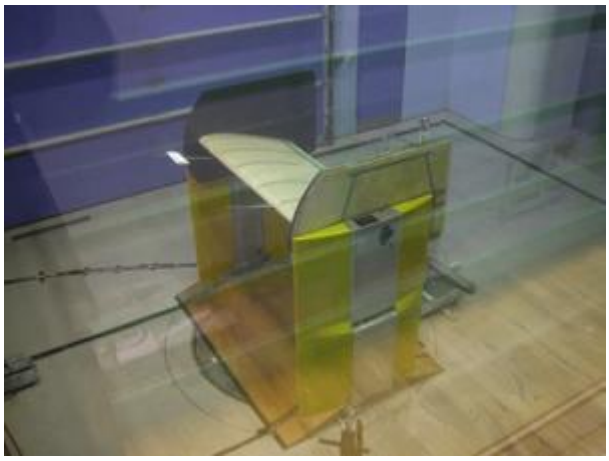
Adapted from materials provided by Purdue University.

Journal Reference:

1. Cherkauer et al. **Hydrologic impacts of projected future climate change in the Lake Michigan region**. *Journal of Great Lakes Research*, 2010; DOI: 10.1016/j.jglr.2009.11.012

http://www.sciencedaily.com/releases/2010/02/100217093258.htm

Successful Wind Tunnel Test of Controllable Rubber Trailing Edge Flap for Wind Turbine Blades



The blade profile, which measures approx. 2 x 1 metres, set up in a test stand in the open jet wind tunnel at the company Velux in Denmark. Two types of sensors for measuring wind loading are mounted on the leading edge of the blade profile. (Credit: Image courtesy of Risø National Laboratory for Sustainable Energy)

ScienceDaily (Feb. 19, 2010) — For some years, the Wind Energy Division at Risø DTU has been working to develop a method for controlling the loads on large wind turbine blades using a flexible trailing edge made of an elastic material which can be controlled by means of compressed air or hydraulics. Now, the invention, which has been called CRTEF (Controllable Rubber Trailing Edge Flap), has been tested in a wind tunnel with promising results.

Today's wind turbine blades, which can measure more than 60 metres in length, are subjected to enormous loads, which means that a blade can flex as much as 4-6 metres during strong gusts. However, the blades are also so long that there can be considerable differences in the loading from the gusts along the blade. In wind farms, surrounding wind turbines also exert considerable influence and generate turbulence, which has a more localised effect.

"It is these local influences which we hope our design will help mitigate. However, in addition to our rubber trailing edge, it also calls for effective sensors and control systems which can tell the system to regulate the flaps according to the local wind conditions along the blade. Right now we are looking at different types of sensors and a trailing edge made of plastic instead of rubber," explains Research Specialist Helge Aagaard Madsen.

In December 2009, the rubber trailing edge was tested in the open jet wind tunnel at the company Velux in Denmark. The test marked the end of a development process which was initiated in 2006. It started with a GAP funding project which ran from 2007 to 2008 and confirmed the operating principle. This was followed by the current project in 2009, supported by Region Zealand, where the rubber trailing edge was tested in the wind tunnel. Along the way, many different prototypes have been developed and manufactured at the Fibre Laboratory at the Materials Research Division at Risø DTU, which also has been part of this development process.

"The operational principle which we have arrived at is very simple and robust, and we also believe that the manufacturing process will be so. The wind tunnel test showed, among other things, that the outward curve of the flap does not change markedly when subjected to wind loads similar to those on a real turbine blade. In addition, we measured the correlation between the deflection of the flap and the change in lift on the blade section. This produced figures which we can enter into our calculation models and then realistically simulate how the flap will reduce the loads on the turbine," says Helge Aagaard Madsen.

"A further bonus of our design is that the moulded rubber trailing edge gives us a sharp edge which produces less noise and greater output. As most blades today are manufactured in two halves and afterwards joined together, the trailing edge will always have a certain thickness. The trailing edge is then ground to make it thinner, but with our design, the blade automatically gets a completely sharp edge."

Up to a moderate gale

The test facilities at Velux have been used in the past to test wind turbine blade profiles, so it was obvious that the design should be tested here. In the wind tunnel it is possible, among other things, to regulate the wind speed, and the blade profile can be turned to simulate a change in wind direction in relation to the profile.

The test set-up consisted of a two-metre-long blade section with a total chord of one metre and a 15 cm rubber flap covering the entire span. The blade incorporated a pneumatic system for controlling the flexible silicone material which the trailing edge is made of. Finally, two sensors were attached to the front of the blade which measured wind direction and speed.

"So far there has been focus on demonstrating and testing the operating principle, but now where we can see that it is a robust and reliable model, which can withstand the strong wind loading, we can start to focus more on optimising the design and working towards a full-scale version," says Helge Aagaard Madsen, adding that one of their concerns was whether strong gusts of wind would counteract the deflection of the rubber trailing edge, which the compressed air caused. But fortunately it was not the case.

The force which the blade is exposed to is based on measurements of the surface pressure across the blade section. The difference in the force on the upper side and lower side of the blade clearly indicates how the movements of the rubber trailing edge can regulate this force and thereby compensate for the fluctuating forces to which a blade is otherwise subjected because of wind gusts."Among other things, we investigated how quickly the rubber trailing edge could regulate, and we tested the flaps to a frequency above 2 Hz. Today, pitch is regulated by turning the entire blade around a bearing at the hub, but this has limitations due to the blade weight of several tons but also because a distributed, variable regulation along the blade is not possible. Consequently, we believe that the control with flaps can supplement the slower pitch regulation really well," explains Peter Bjørn Andersen.

A step on the way to full-scale

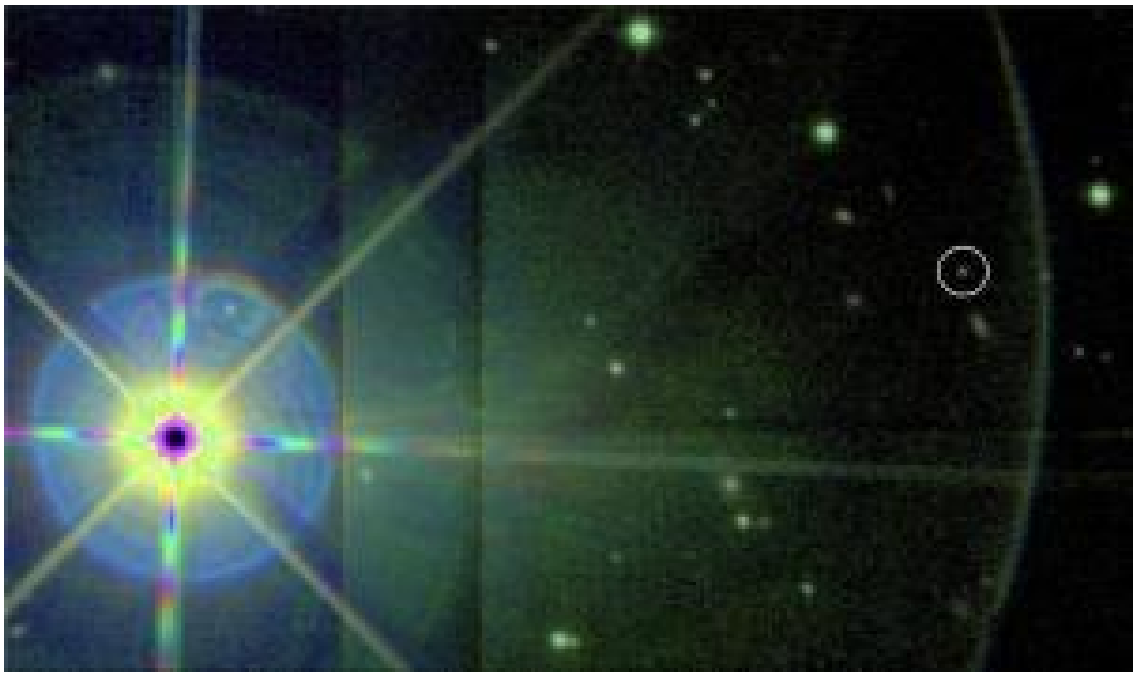
Now that the operating principle has been thoroughly tested, the next step in the project is to develop the technology towards a stage where the rubber trailing edge flap is ready for testing in a full-scale prototype model. The researchers will work on optimising the design so the deflection will be as big as possible for a given pressure in the voids within the trailing edge. Durability is another important issue, as is developing systems for supplying compressed air or hydraulic power."We are in contact with a number of companies who are interested in working with us on these issues, and it is vital for the further development of the technology that we involve industry as this is where the systems will be manufactured at the end of the day. The plan is thus to launch a new development project which involves close corporation between on one side the research groups at Risoe DTU in the Wind Energy Division and in the Materials Research Division and on the other side these companies in order to bring the rubber trailing edge flap technology to a stage where it is ready for testing on a full-scale wind turbine," concludes Helge Aagaard Madsen.

Story Source:

Adapted from materials provided by Risø National Laboratory for Sustainable Energy.

http://www.sciencedaily.com/releases/2010/02/100217093654.htm

Red Dwarf-Red Giant Binary Pair of Stars Found



Eta Cancri: Researchers in the UK and China recently discovered a binary pair of red stars -- one giant, one dwarf.

ScienceDaily (Feb. 19, 2010) — A binary pair of red stars, one giant one dwarf, has been discovered by a collaboration of astrophysicists from the University of Hertfordshire and The Chinese Academy of Sciences.

The discovery, which is due to be published in the *Monthly Notices of the Royal Astronomical Society* later this month reports that the researchers have identified an ultra-cool companion to the bright red giant star Eta Cancri, using the UK Infrared Telescope in Hawaii and the Sloan Digital Sky Survey in New Mexico.

Ultra-cool dwarfs are star-like objects, but with surface temperatures much cooler than normal stars -- less than 2000 degrees (compare this to the Sun's temperature of about 6000 degrees). Exotic dusty clouds condense out at such ultra-cool temperatures, leading to objects that are hybrid in nature -- with characteristics of both stars and giant planets like Jupiter.

Red giant stars are much bigger and more massive, and are evolving towards the end of their life (our Sun will become a red giant in about 5 billion years). But as they evolve towards their demise they can reveal information about their age and chemical composition.

Against the backdrop of unknown ultra-cool cloudy physics, the new binary is providing a beacon to test our understanding. Both members will have a shared history and origin, and the team's detailed studies of the giant star have been able to reveal the age and chemical composition of the ultra-cool companion Eta Cancri B.

The discovery was made by ZengHua Zhang, a researcher previously at the Yunnan Observatory of The Chinese Academy of Sciences and now studying for his PhD with Dr David Pinfield at the University of Hertfordshire Centre for Astrophysics Research.

"China sees it as crucial to pursue excellence in cutting edge astrophysics as part of its fast growing research enterprise" said ZengHua Zhang. "Collaboration with overseas experts is very important to us, and that is why I have come to do my PhD in the University of Hertfordshire."

In the infrared, the "UKIRT Infrared Deep Sky Survey" on the UK Infrared Telescope in Hawaii detected the warm glow of Eta Cancri B. And in the optical (where the human eye is sensitive) the "Sloan Digital Sky Survey" measured its characteristic red colour.

"The power of these large scale sky surveys is yielding many fascinating low temperature discoveries, previously beyond our reach," said Dr. Pinfield. "You have to search for needles in a haystack, but rare finds like Eta Cancri B provide a guiding light for our understanding of the complex atmospheres that enrobe the Sun's coolest neighbours as well as warm giant planets."

The team is making further studies of this crucial binary pair using some of the world's largest telescopes, to fully explore it's qualities as a defining benchmark system.

Story Source:

Adapted from materials provided by University of Hertfordshire, via AlphaGalileo.

http://www.sciencedaily.com/releases/2010/02/100216221147.htm

Cooling Inflammation for Healthier Arteries

Scientists have found additional indications that eating oats may have more potential health benefits towards preventing coronary heart disease beyond lowering blood cholesterol. (Credit: Photo by Peggy Greb.)

ScienceDaily (Feb. 19, 2010) — Agricultural Research Service (ARS)-funded scientists have reported new reasons for choosing "heart-healthy" oats at the grocery store.

Nutritionist Mohsen Meydani, director of the Vascular Biology Laboratory at the Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University in Boston, Mass., led the research on the oat compounds, called avenanthramides. Meydani previously has shown that phenolic antioxidants in oats obstruct the ability of blood cells to stick to artery walls.

Chronic inflammation inside the arterial wall is part of the process that eventually leads to a disorder known as atherosclerosis. Meydani and colleagues have reported findings that suggest the avenanthramides of oats decrease the expression of inflammatory molecules. The study showed that forms of avenanthramides possess potential anti-inflammatory properties through inhibiting factors that are linked with activating proinflammatory cytokines.

Cytokines are small proteins released by cells while seeking to protect and repair tissue. Some trigger inflammation, for example, while responding to infection. Inhibiting inflammation through diet, drugs, or key nutrients is considered to be of great benefit in preventing atherosclerosis. Details of this study can be found in the scientific journal *Free Radical Biology & Medicine*.

The study provides additional indications of the potential health benefit of oat consumption in the prevention of coronary heart disease beyond its known effect through lowering blood cholesterol.

Story Source:

Adapted from materials provided by USDA/Agricultural Research Service.

http://www.sciencedaily.com/releases/2010/02/100216142326.htm

No Place to Hide: Missing Primitive Stars Outside Milky Way Uncovered

The Fornax dwarf galaxy is one of our Milky Way's neighbouring dwarf galaxies. The Milky Way is, like all large galaxies, thought to have formed from smaller galaxies in the early days of the Universe. These small galaxies should also contain many very old stars, just as the Milky Way does, and a team of astronomers has now shown that this is indeed the case. This image was composed from data from the Digitized Sky Survey 2. (Credit: ESO/Digitized Sky Survey 2)

ScienceDaily (Feb. 18, 2010) — After years of successful concealment, the most primitive stars outside our Milky Way galaxy have finally been unmasked. New observations using ESO's Very Large Telescope have been used to solve an important astrophysical puzzle concerning the oldest stars in our galactic neighbourhood -- which is crucial for our understanding of the earliest stars in the Universe.

"We have, in effect, found a flaw in the forensic methods used until now," says Else Starkenburg, lead author of the paper reporting the study. "Our improved approach allows us to uncover the primitive stars hidden among all the other, more common stars."

Primitive stars are thought to have formed from material forged shortly after the Big Bang, 13.7 billion years ago. They typically have less than one thousandth the amount of chemical elements heavier than hydrogen and helium found in the Sun and are called "extremely metal-poor stars" [1]. They belong to one of the first generations of stars in the nearby Universe. Such stars are extremely rare and mainly observed in the Milky Way.

Cosmologists think that larger galaxies like the Milky Way formed from the merger of smaller galaxies. Our Milky Way's population of extremely metal-poor or "primitive" stars should already have been present in the dwarf galaxies from which it formed, and similar populations should be present in other dwarf galaxies. "So far, evidence for them has been scarce," says co-author Giuseppina Battaglia. "Large surveys conducted in the last few years kept showing that the most ancient populations of stars in the Milky Way and dwarf galaxies did not match, which was not at all expected from cosmological models."

Element abundances are measured from spectra, which provide the chemical fingerprints of stars [2]. The Dwarf galaxies Abundances and Radial-velocities Team [3] used the FLAMES instrument on ESO's Very Large Telescope to measure the spectra of over 2000 individual giant stars in four of our galactic neighbours, the Fornax, Sculptor, Sextans and Carina dwarf galaxies. Since the dwarf galaxies are typically 300 000 light years away -- which is about three times the size of our Milky Way -- only strong features in the spectrum could be measured, like a vague, smeared fingerprint. The team found that none of their large collection of spectral fingerprints actually seemed to belong to the class of stars they were after, the rare, extremely metal-poor stars found in the Milky Way.

The team of astronomers around Starkenburg has now shed new light on the problem through careful comparison of spectra to computer-based models. They found that only subtle differences distinguish the chemical fingerprint of a normal metal-poor star from that of an extremely metal-poor star, explaining why previous methods did not succeed in making the identification.

The astronomers also confirmed the almost pristine status of several extremely metal-poor stars thanks to much more detailed spectra obtained with the UVES instrument on ESO's Very Large Telescope. "Compared to the vague fingerprints we had before, this would be as if we looked at the fingerprint through a microscope," explains team member Vanessa Hill. "Unfortunately, just a small number of stars can be observed this way because it is very time consuming."

"Among the new extremely metal-poor stars discovered in these dwarf galaxies, three have a relative amount of heavy chemical elements between only 1/3000 and 1/10 000 of what is observed in our Sun, including the current record holder of the most primitive star found outside the Milky Way," says team member Martin Tafelmeyer.

"Not only has our work revealed some of the very interesting, first stars in these galaxies, but it also provides a new, powerful technique to uncover more such stars," concludes Starkenburg. "From now on there is no place left to hide!"

Notes

[1] According to the definition used in astronomy, "metals" are all the elements other than hydrogen and helium. Such metals, except for a very few minor light chemical elements, have all been created by the various generations of stars.

[2] As every rainbow demonstrates, white light can be split up into different colours. Astronomers artificially split up the light they receive from distant objects into its different colours (or wavelengths). However, where we distinguish seven rainbow colours, astronomers map hundreds of finely nuanced colours, producing a *spectrum* -- a record of the different amounts of light the object emits in each narrow colour band. The details of the spectrum -- more light emitted at some colours, less light at others -- provide tell-tale signs about the chemical composition of the matter producing the light.

[3]The Dwarf galaxies Abundances and Radial-velocities Team (DART) has members from institutes in nine different countries.

More information

This research was presented in a paper to appear in *Astronomy and Astrophysics*. Another paper is also in preparation (Tafelmeyer et al.) that presents the UVES measurements of several primitive stars.

Story Source:

Adapted from materials provided by ESO.

Journal Reference:

1. E. Starkenburg et al. **The NIR Ca II triplet at low metallicity: Searching for extremely low-metallicity stars in classical dwarf galaxies**. *Astronomy and Astrophysics*, 2010; DOI: 10.1051/0004-6361/200913759

http://www.sciencedaily.com/releases/2010/02/100217093251.htm

Honeybees Guide Neurological Discoveries

Honeybee visiting a flower. Through a new study of honeybees, scientists at UQ's Queensland Brain Institute have discovered the brain has an advanced ability to isolate specific odours and recollect smells. (Credit: iStockphoto)

ScienceDaily (Feb. 18, 2010) — Every moment of every day the brain is forced to process thousands of separate odorants from the world around us.

Through a new study of honeybees, scientists at UQ's Queensland Brain Institute have discovered the brain has an advanced ability to isolate specific odours and recollect smells.

"There's a lot of information coming into the brain whenever a scent is detected and it would be difficult to process it all," lead researcher Dr Judith Reinhard said.

"We've found that honeybees pick only a handful of so-called 'key odorants' out of every complex aroma that they really learn. They may remember just two or three odorants from a couple of hundred, the rest are ignored."

Colleague Dr Charles Claudianos said if you had to learn the hundreds of compounds your brain would be overwhelmed with information.

"By choosing the key odorants, you can function more effectively without being swamped," Dr Charles Claudianos said.

The research, published in the latest edition of *PLoS ONE*, has also allowed the scientists to explore how the learning of odours affects molecules that have been linked to autism and schizophrenia. During their studies, the researchers found that the honeybee brain responds to sensory experience.

"The honeybee brain -- like the human brain -- adapts to its sensory environment by adjusting the expression of these molecules," Dr Claudianos said.

Dr Reinhard said the findings could also have an enormous impact on Australian farming. Using the honeybee's capacity to extract key odorants, scientists will be able to isolate these odorants from the complex aromas of crops. They can then use the key odorants to train honeybees to pollinate specific crops.

"Farmers often have problems making honeybees focus on the crop -- the bees go astray and go to nearby forests or national parks and the farmers don't get a good yield," Dr Reinhard said.

"If we know the key odorants of the almond aroma, for example, we could use these to train the honeybees in the hive to focus only on pollinating almonds. Then you'd have a much higher likelihood the honeybees would stay in the crop and pollinate it."

Now the focus for the QBI scientists will be whether humans use the same technique of learning specific key odorants so our brain is not overwhelmed by too much sensory information -- early research suggests we do.

Story Source:

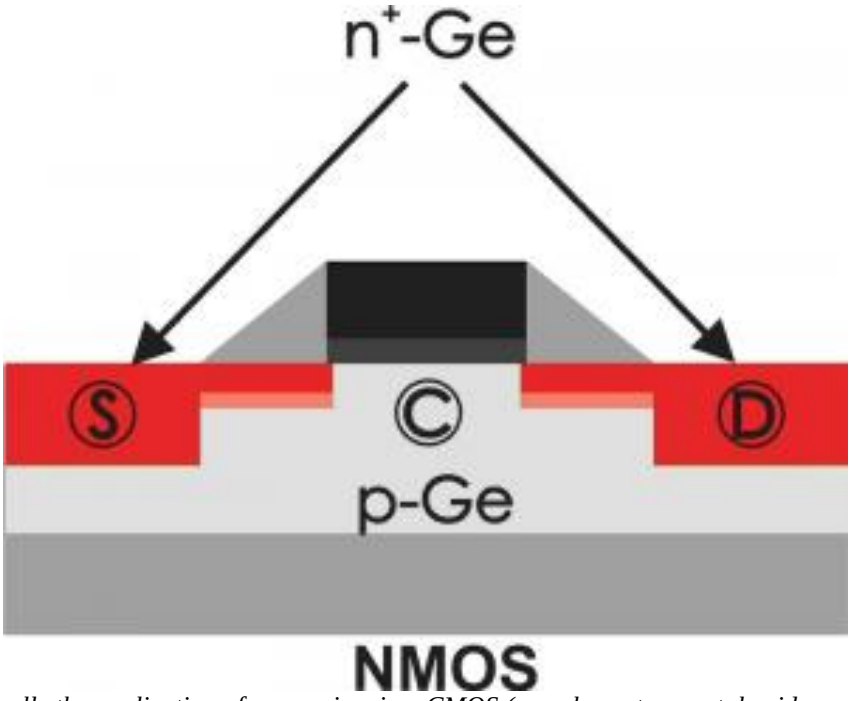
Adapted from materials provided by University of Queensland.

Journal Reference:

1. Reinhard et al. **Honeybees Learn Odour Mixtures via a Selection of Key Odorants**. *PLoS ONE*, 2010; 5 (2): e9110 DOI: 10.1371/journal.pone.0009110

http://www.sciencedaily.com/releases/2010/02/100216225117.htm

A Step Towards Germanium Nanoelectronics



The figure shows schematically the application of germanium in a CMOS (complementary metal oxide semiconductor) circuit. Note that germanium is only used in the regions of source (S), drain (D) and channel (C). Source and drain contain high concentration of foreign atoms (dopants) which provide the excess of free electrons (n+ regions) or holes (p+ regions). (Credit: Image courtesy of Forschungszentrum Dresden Rossendorf)

ScienceDaily (Feb. 18, 2010) — The use of germanium instead of silicon as basic material of transistors would enable faster chips containing smaller transistors. However, a number of problems still have to be solved.

Transistors are produced using foreign atoms that are implanted into the semiconductor material so that it becomes partly conducting. As this production step damages the material, it has to be repaired by subsequent annealing. So far it has not been possible to produce large-scale integrated transistors of a specific type (NMOS) using germanium. The reason: phosphorus atoms are strongly redistributed within the material during annealing.

Two novel techniques, which were applied by scientists of the research center Forschungszentrum Dresden-Rossendorf (FZD) and international colleagues, overcome this dilemma.

Higher switching speeds than in silicon could be achieved using germanium and some other semiconductors. Germanium is particularly attractive since it could be easily integrated into existing technological processes. Germanium was the basic material of first-generation transistors before it was replaced by silicon at the end of the 1960s. This was due to the excellent electronic properties of the interface between the semiconductor silicon and its insulating and passivating oxide. However, this advantage cannot be utilized if transistor dimensions are further reduced since the oxide must then be replaced by so-called high-k dielectrics. This again stimulates science and industry to search for the most suitable basic material.

By inserting foreign atoms the conductivity of semiconductors can be varied in a purposeful way. One possibility is ion implantation (ions are charged atoms) with subsequent heat treatment, which is called annealing. Annealing of the germanium crystal is necessary as the material is heavily damaged during

implantation, and leads to the requested electronic properties. While these methods allow for the manufacturing of p-channel transistors (PMOS) according to future technology needs (22 nanometer technology node), it was not possible to produce corresponding n-channel transistors (NMOS) using germanium. This is due to the strong spatial redistribution (diffusion) of the phosphorus atoms which have to be used in manufacturing the n^+ regions.

Physicists from the FZD applied a special annealing method that enables repairing the germanium crystal and yields good electrical properties without the diffusion of phosphorus atoms. The germanium samples were heated by short light pulses of only a few milliseconds. This period is sufficient in order to restore the crystal quality and to achieve electrical activation of phosphorus, but it is too short for the spatial redistribution of the phosphorus atoms. The light pulses were generated by the flash lamp equipment which was developed at the research center FZD. Analysis of the electrical and structural properties of the thin phosphorus-doped layers in germanium was performed in close collaboration with colleagues from the Belgian microelectronics center IMEC in Leuven and from the Fraunhofer-Center for Nanoelectronic Technologies (CNT) in Dresden.

An alternative method to suppress phosphorus diffusion in germanium has been investigated by an international team consisting of researchers from Germany, Denmark and the USA, amongst them physicists from FZD. After ion implantation of phosphorus into germanium the sample was heated to a given temperature and then irradiated by protons. It could be demonstrated that this treatment leads to the reduction of phosphorus diffusion, too. The results of these experiments are explained by the influence of certain lattice defects (self-interstitials) that annihilate those lattice defects (vacancies) which are responsible for the mobility of the phosphorus atoms.

Thus, FZD physicists and their colleagues demonstrated that in principle it is possible to fabricate germanium-based n-channel transistors (NMOS) with dimensions corresponding to the most advanced technological requirements.

Story Source:

Adapted from materials provided by Forschungszentrum Dresden Rossendorf, via AlphaGalileo.

Journal References:

1. C. Wündisch, M. Posselt, B. Schmidt, V. Heera, T. Schumann, A. Mücklich, R. Grötzschel, W. Skorupa, T. Clarysse, E. Simoen, H. Hortenbach. **Millisecond flash lamp annealing of shallow implanted layers in Ge**. *Applied Physics Letters*, 2009; 95 (25): 252107 DOI: 10.1063/1.3276770
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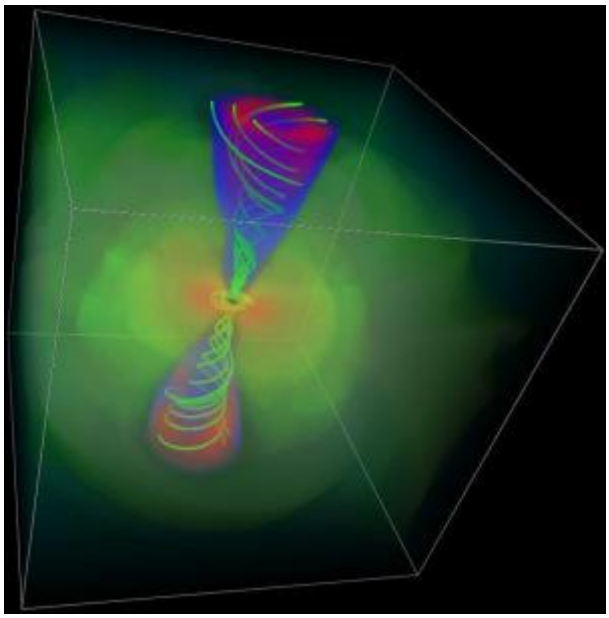
http://www.sciencedaily.com/releases/2010/02/100217093936.htm

Jets of Particles Streaming from Black Holes in Far-Away Galaxies Different Than Previously Thought



Recent observations of blazar jets require researchers to look deeper into whether current theories about jet formation and motion require refinement. This simulation, courtesy of Jonathan McKinney (KIPAC), shows a black hole pulling in nearby matter (yellow) and spraying energy back out into the universe in a jet (blue and red) that is held together by magnetic field lines (green).

ScienceDaily (Feb. 18, 2010) — Jets of particles streaming from black holes in far-away galaxies operate differently than previously thought, according to a study published February 17 in *Nature*. The new study reveals that most of the jet's light -- gamma rays, the universe's most energetic form of light -- is created much farther from the black hole than expected and suggests a more complex shape for the jet.

The research was led by scientists at the Kavli Institute for Particle Astrophysics and Cosmology, jointly located at the Department of Energy's SLAC National Accelerator Laboratory and Stanford University, with participation from scientists from around the world. The study included data from more than 20 telescopes including the Fermi Gamma-ray Space Telescope and KANATA telescope.

High above the flat Milky Way galaxy, bright galaxies called blazars dominate the gamma-ray sky, discrete spots on the dark backdrop of the universe. As nearby matter falls into the black hole at the center of a blazar, "feeding" the black hole, it sprays some of this energy back out into the universe as a jet of particles.

"As the universe's biggest accelerators, blazar jets are important to understand," said KIPAC Research Fellow Masaaki Hayashida, who serves as corresponding author on the paper with KIPAC Astrophysicist Greg Madejski. "But how they are produced and how they are structured is not well understood. We're still looking to understand the basics."

Researchers had previously theorized that such jets are held together by strong magnetic field tendrils, while the jet's light is created by particles revolving around these wisp-thin magnetic field "lines."

Yet, until now, the details have been relatively poorly understood. The recent study upsets the prevailing understanding of the jet's structure, revealing new insight into these mysterious yet mighty beasts.

"This work is a significant step toward understanding the physics of these jets," said KIPAC Director Roger Blandford. "It's this type of observation that is going to make it possible for us to figure out their anatomy."

Locating the Gamma Rays

Over a full year of observations, the researchers focused on one particular blazar jet, located in the constellation Virgo, monitoring it in many different wavelengths of light: gamma-ray, X-ray, optical, infrared and radio. Blazars continuously flicker, and researchers expected continual changes in all types of light. Midway through the year, however, researchers observed a spectacular change in the jet's optical and gamma-ray emission: a 20-day-long flare in gamma rays was accompanied by a dramatic change in the jet's optical light.

Although most optical light is unpolarized -- consisting of light rays with an equal mix of all polarizations or directionality -- the extreme bending of energetic particles around a magnetic field line can polarize light. During the 20-day gamma-ray flare, optical light streaming from the jet changed its polarization. This temporal connection between changes in the gamma-ray light and changes in the optical light suggests that both types of light are created in the same geographical region of the jet; during those 20 days, something in the local environment altered to cause both the optical and gamma-ray light to vary.

"We have a fairly good idea of where in the jet optical light is created; now that we know the gamma rays and optical light are created in the same place, we can for the first time determine where the gamma rays come from," said Hayashida.

This knowledge has far-reaching implications about how energy escapes a black hole. The great majority of energy released in a jet escapes in the form of gamma rays, and researchers previously thought that all of this energy must be released near the black hole, close to where the matter flowing into the black hole gives up its energy in the first place. Yet the new results suggest that -- like optical light -- the gamma rays are emitted relatively far from the black hole. This, Hayashida and Madejski said, in turn suggests that the magnetic field lines must somehow help the energy travel far from the black hole before it is released in the form of gamma rays.

"What we found was very different from what we were expecting," said Madejski. "The data suggest that gamma rays are produced not one or two light days from the black hole [as was expected] but closer to one light year. That's surprising."

Rethinking Jet Structure

In addition to revealing where in the jet light is produced, the gradual change of the optical light's polarization also reveals something unexpected about the overall shape of the jet: the jet appears to curve as it travels away from the black hole.

"At one point during a gamma-ray flare, the polarization rotated about 180 degrees as the intensity of the light changed," said Hayashida. "This suggests that the whole jet curves."

This new understanding of the inner workings and construction of a blazar jet requires a new working model of the jet's structure, one in which the jet curves dramatically and the most energetic light originates far from the black hole. This, Madejski said, is where theorists come in. "Our study poses a very important challenge to theorists: how would you construct a jet that could potentially be carrying energy so far from the black hole? And how could we then detect that? Taking the magnetic field lines into account is not simple. Related calculations are difficult to do analytically, and must be solved with extremely complex numerical schemes."

Theorist Jonathan McKinney, a Stanford University Einstein Fellow and expert on the formation of magnetized jets, agrees that the results pose as many questions as they answer. "There's been a long-time controversy about these jets -- about exactly where the gamma-ray emission is coming from. This work constrains the types of jet models that are possible," said McKinney, who is unassociated with the recent study. "From a theoretician's point of view, I'm excited because it means we need to rethink our models."

As theorists consider how the new observations fit models of how jets work, Hayashida, Madejski and other members of the research team will continue to gather more data. "There's a clear need to conduct such observations across all types of light to understand this better," said Madejski. "It takes a massive amount of coordination to accomplish this type of study, which included more than 250 scientists and data from about 20 telescopes. But it's worth it."

With this and future multi-wavelength studies, theorists will have new insight with which to craft models of how the universe's biggest accelerators work.

Story Source:

Adapted from materials provided by DOE/SLAC National Accelerator Laboratory.

Journal Reference:

1. The Fermi-LAT Collaboration and members of the 3C 279 multi-band campaign. **A change in the optical polarization associated with a γ-ray flare in the blazar 3C□279**. *Nature*, 463, 919-923 (18 February 2010) DOI: 10.1038/nature08841

http://www.sciencedaily.com/releases/2010/02/100217142635.htm

System Unveiled for Regulating Anaesthesia Via Computer

Patient connected to the anesthesia control system. (Credit: Albino Méndez et al.)

ScienceDaily (Feb. 18, 2010) — A team of researchers from the Canary Islands has developed a technique for automatically controlling anaesthesia during surgical operations. The new system detects the hypnotic state of the patient at all times and supplies the most appropriate dose of anaesthetic.

"This is an efficient control technique which regulates anaesthesia in operating theatres by computer, with the aim of adapting the dose of the drug administered according to the individual characteristics of each patient," Juan Albino Méndez, lead author of the study and a researcher in the Anaesthesia Control Group at the University of La Laguna (ULL), said.

The group has developed an IT tool together with the team of anaesthetists from the University Hospital of the Canary Islands, in order to facilitate the work of these health professionals. The new system, which has been published in Computer Methods in Biomechanics and Biomedical Engineering, keeps the patient in the desired hypnotic state throughout the operation.

The system uses sensors and a monitor to record the patient's encephalogram (EEG) and bispectral index (BIS), a parameter without units that measures hypnotic state and relates this to the patient's level of consciousness.

The BIS value fluctuates between 100 (maximum possible state of alertness) and 0 (lack of cortical electrical activity, the state of deepest unconsciousness). This research focuses on the BIS region involved in general anaesthesia, between 40 and 60.

Dose-calculating algorithms

The data are processed by a computer with specific control software, which can control the pump that injects the anaesthetic in order to regulate the amount given. The IT application is based on adaptive PID (Proportional Integral Derivative) algorithms, a control-loop feedback mechanism that automatically controls the right dose according to the measured and desired values.

In order to validate the technique, the researchers successfully carried out simulations using various models they developed themselves, and also tested it on 15 volunteer patients, aged between 30 and 60, at the University Hospital of the Canary Islands.

"The first results obtained, both in surgery and in the simulations, show that the system operates very satisfactorily, and has surgical applications with well-founded expectations of success," says Albino Méndez.

The scientists hope that the method will help to improve anaesthetic-dosing performance during operations and will improve patient recovery times, as well as reducing the costs of operations.

The study was carried out using a commonly-used anaesthetic, propofol, but it could have been done on others, such as isoflurane. The technique also has applications for regulating other physiological variables, such as blood glucose levels, temperature or blood pressure.

The immediate challenges for the team, aside from further developing the algorithmic part of the system, are to incorporate analgesia and muscle relaxation variables into the platform in order to provide anaesthetists with a comprehensive tool.

Story Source:

Adapted from materials provided by Plataforma SINC.

Journal Reference:

1. Mendez et al. **Adaptive computer control of anesthesia in humans**. *Computer Methods in Biomechanics & Biomedical Engineering*, 2009; 12 (6): 727 DOI: 10.1080/10255840902911528

http://www.sciencedaily.com/releases/2010/02/100218092854.htm

Everyday Grass Could Provide Green Fuel

Dr Richard Lord, Reader in Environmental Geochemistry and Sustainability, (left) with Richard Green, BioReGen Project Officer, both at Teesside University, Middlesbrough, pictured on the banks of the River Tees. (Credit: Image courtesy of University of Teesside)

ScienceDaily (Feb. 18, 2010) — A five-year research project has come up with a way of generating green energy from a humble everyday grass.

Researchers at Teesside University's Contaminated Land and Water Centre began the project in 2004 to see which plants could best be grown on brownfield sites as a way of improving unsightly blots on the landscape.

Now, the research by the BioReGen (Biomass, Remediation, re-Generation) project team has revealed that reed canary grass can be turned into an excellent fuel for biomass power stations and, on a smaller scale, boilers in buildings like schools.

The native British grass is turned into bricks and pellets. These not only burn well but also don't add to greenhouse gases or contribute to global warming.

The team experimented with four types of plant, willow trees, the current favourite for biomass power stations, and the miscanthus, reed canary and switch grasses.

Tests were carried out on sites around the region with work supported by a 1.2m Euros grant from the European Union's LIFE-Environment research programme.

Dr Richard Lord, Reader in Environmental Geochemistry and Sustainability, said: "We have narrowed the plants down to reed canary grass because it grows well on poor soils and contaminated industrial sites. That is significant because in areas like Teesside, and many similar ones around the country, there are a lot of marginal or brownfield sites on which reed canary grass can be grown.

"Selecting such sites means that the grass can be grown without taking away land which would otherwise be used in food production, a key concern for those involved in the biomass and biofuel sectors."

Having reached maturity, which takes two years, reed canary grass is harvested and baled up before being turned into bricks and pellets.

Dr Lord said: "The test burnings have shown that reed canary grass produces a good, clean fuel without picking-up contamination from the soil.

"Reed canary grass has great potential because it offers a suitable use for unsightly brownfield sites while producing an excellent fuel at a time when the world is crying out for new ways of producing green energy.

"Our research also suggests that the end product is improved soil quality and biodiversity at the greened-up sites.

"We are now examining ways in which we can commercialise this idea and are already talking to a number of major biomass power station operators."

Story Source:

Adapted from materials provided by University of Teesside.

http://www.sciencedaily.com/releases/2010/02/100216221301.htm