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Unfurling a Life of Creative Exuberance

By HOLLAND COTTER

Fred R. Conrad/The New York Times

Among the 200 or so works on view in the de Kooning show at MoMA are his late works, including, from left, “The Cat's Meow” (1987), “Untitled VI” (1986) and “Conversation” (1987).

The Museum of Modern Art has never known quite what to do with Willem de Kooning. You can package Jackson Pollock as drips and Barnett Newman as zips, but de Kooning, who painted both opulent abstractions and big, blowsy dames, resists easy branding. So, apart from a show of late work in 1997, the museum has neglected him, until now.

With the opening of “De Kooning: A Retrospective” this coming Sunday decades of overdue debt are paid in full. The show, which fills MoMA’s entire sixth floor with some 200 paintings, drawings and sculptures, is exhaustively comprehensive, exhaustingly large and predictably awe inspiring. It not only positions de Kooning far forward in a 20th-century American cavalcade of stars, it turns his career into a kind of Rose Bowl float of creative exuberance and invention.

Most usefully the show lets de Kooning be complicated: it presents his art as a bifurcated yet unitary phenomenon. John Elderfield, chief curator emeritus of painting and sculpture at MoMA, unfurls seven decades of work through seven galleries. In each we see abstract and figurative paintings of roughly the same date not just side by side but also interacting, intertwining, merging identities; abstraction breathes, smiles and bleeds; figures shimmer and shudder apart into color and line.

In its shape the show adheres to a classic cradle-to-grave survey model, beginning with a still life that de Kooning painted at the age of 12 in his Dutch hometown, Rotterdam. By his early teenage years he was already working in a commercial design firm, where he learned sign-lettering and paste-up techniques like tracing, copying and layering.

All of this came in handy while looking for work when he first arrived, after stowing away on a freighter, in the United States in 1926. More important in the long run, his design training, with its emphasis on creating an organic-looking whole from many pieces, ended up as the formal bedrock of his art.

He was lucky in being, by temperament, chronically hungry and omnivorous. In the first two sections of the show, which take us in giant steps up to 1949, we see him devouring his way through visual history past and present, gobbling up images from Ingres, Rubens, Soutine and Picasso; from contemporaries like Arshile Gorky; and from movie ads, Sunday comics and the graphics in New York police gazettes.

While some artists and thinkers of the day were promoting an art of utopian purity, one that required shutting a door between art and life, de Kooning's appetite took him in the opposite, though really no less utopian, direction. He wanted to open everything up, to bring — to squeeze — everything into art: high, low; old, new; savagery, grace.

And so he did, in a laborious, pieced-together, piled-up, revision-intensive way. Far from being the sort of impulsive, gut-spilling artist implied by the term "action painting," he was a deliberator. Every painting was a controlled experiment.

Typically he would start with a drawing, add paint, draw on top of the paint, scrape the surface down, draw more images traced and transferred from elsewhere, add paint to them, and on and on. Given this process, it seems astonishing that he was so prolific, until you remember that he was virtually never not working: trying this, tweaking that, scrapping failures, starting afresh.

Whenever the enormousness of the MoMA show gets you down, stop in front of one picture, almost any one, and linger. The basic, energy-generating dynamic of de Kooning's art operates in microcosm in nearly every single thing he did after the mid-1940s.

Experiencing the physical mechanics of his art close up, in action, is the real thrill of the show. To engage with it is to meet a person rather than just visit a monument.

The late 1940s was when de Kooning first caught fire, when abstraction and figures first merged. That's the story of "Pink Angels" from around 1945, the final painting in his first series devoted to images of women. From painting to painting, the single seated figure in the series grows less naturalistic, begins to lose its contours, to dissolve into its surroundings.

By "Pink Angels" the figures have lost their clothes, lost their faces, and become monstrously voluptuous, approximately human forms made from chunks of cut-up flesh. It's as if we're seeing the cleanup phase of a sloppy autopsy, but one that took place inside a chamber of gold.

How such a scene can be beautiful is hard to say, but it is. De Kooning once famously observed that "flesh was the reason why oil paint was invented." It's important to remember that he wasn't thinking only of the milk-white flawless flesh of Titian courtesans but also flesh that bruised, bled, rotted away. The vanitas awareness of the 17th-century Dutch still-life painters was strong in him, the bass note to his force-of-life vigor.

In "Pink Angels" his nods to Picasso, Matisse and Miró are easy to spot, but one detail, the image of a fish head with the gaping mouth that forms the angel's foot, is a puzzler. It's lifted from a 16th-century print of "The Last Judgment" by Pieter Bruegel the Elder. In 1946 de Kooning painted a picture called "Judgment Day." From a distance it seems vaguely abstract. (Again, much of his work looks vague from afar, particularly in MoMA's galleries, which are way overscaled for this art.) But up close you see that it's packed with four crablike figures: the angels of the Apocalypse crouched in a huddle.

Significantly, the work that finally put him on the art-world map has no figures, or none in plain sight. His first New York solo in 1948, when was 43, was made up of all-but-imageless paintings. Some were done primarily in black and white, with white paint twisting in thin lines, like cracks spreading in smashed glass sheets, over the dark ground.

Within the art world the show was a sensation. De Kooning was declared, by an approving, territory-marking Clement Greenberg, "an outright 'abstract' painter." The skeins of white paint were read as a kind of expressive calligraphy. The reductive palette, which many other artists would adopt, was taken as a sign of existential seriousness. De Kooning suddenly found himself centrally placed within a critical cordon sanitaire set up by Greenberg and others for the development of a new, advanced American modernism.

De Kooning could easily have stayed within those bounds, nailing down a signature look and turning out reliable product for reliable reward. But he didn't do that. He made more black-and-white pictures but simultaneously painted images of women, which no one seemed to notice. In 1953, when he exhibited his third "Woman" series, the paintings were so outrageous that the art world had to pay attention, and did.

These pictures of busty Gorgons with slashed-out bodies, flyaway fingers and equine grins caused fits.

Instantly accusations of misogyny started flying, though de Kooning's main sin was his perceived defection from the vanguard program. To true believers the "Woman" paintings were profoundly retrogressive.

Looking at them now we can pick up conceptual links, however coincidental, to work by that most radical of outsider-insider artists, Marcel Duchamp, whose confoundingly erotic, morbid and witty "Étant Donnés" was already secretly in progress. And through the wide-angle view afforded by a retrospective we can see thoroughly, and logically, how abstraction and figuration interlocked in de Kooning's art of this time.

We can also imagine how difficult it must have been for him psychologically to sustain both modes in the face of an establishment that wanted only one and vehemently rejected the other.

Over all de Kooning's output through the 1950s gives a sense of being made under exceptional pressure. The energy is fixed at crescendo level. The surfaces in paintings like "Gotham News" (1955) are ugly-thick and distressed. The colors are chaotic, with streaks of red jabbing out like police-car lights. Everything looks frenzied and noisy, as if done to the sound of alarms.

Then there's this absolutely amazing change of tempo and atmosphere, like the moment in a Mahler symphony when grinding marches stop, and you're in a pastoral realm of cowbells and celestas.

In the late 1950s de Kooning started spending time outside New York City. He moved permanently to the Springs on Long Island in 1963. "Rosy-Fingered Dawn at Louse Point," with its references to Homer and to a spit of land and sea near his new studio, dates from that year. With its jonquil yellows, bluebird blues and Tiepolo pinks, it has a lifted-up joyousness unseen in his art before.

The calm didn't last. More women arrived, undulating and splitting open like wounds. So did de Kooning's first sculptures: blobby, woozy little bronze figures that turn into blobby bigger figures. The impression made in this section of the show is of prolix distraction, with drawings of crucifixions, images of Picassoid satyrs, and oleaginous paintings that suggest food-processor versions of earlier things.

The 1980s brought another clearing out. Suddenly there are just three colors, Mondrian's primaries — red, yellow and blue — drawn out in thin banners over pure white fields. By this point de Kooning was showing sign of Alzheimer's disease, which was far advanced by 1987, the year of the show's last painting. When this late work appeared at MoMA in 1997, the year de Kooning died, some dismissed it as a mere byproduct of

pathology. I admire a lot of de Kooning; I love these last pictures. If Mr. Elderfield's exhibition had done nothing more than provide a context for them, it would have done a lot.

Of course it does much more. In its scale, crème-de-la-crème editing and processional sweep it's MoMA in excelsis, and for many people it will probably represent this institution's history writing at its best. Yet for a while now the museum has been immersed in another history writing project, and an even more essential one, in its continuing and undersung efforts to historicize Conceptualism, the single most influential art movement of the last third of the 20th century.

Conceptual Art, in its classic 1960s form, might appear, at first glance, to be the very opposite of de Kooning's art, though they have much in common. Both are equally obsessed with the material world, whether in trying to erase or embrace it. Both privilege ideas above ego. (De Kooning said many times that his art incorporated but was not about personal expression.) And both are fundamentally expansive in spirit. Conceptualism keeps open a door through which all kinds of fresh creative impulses can flow. The art of de Kooning, so generous and undoctrinaire, does the same.

"De Kooning: A Retrospective" opens on Sunday and runs through Jan. 9 at the Museum of Modern Art; (212) 708-9400, moma.org.

http://www.nytimes.com/2011/09/16/arts/design/de-kooning-a-retrospective-at-moma-review.html

Geoengineering trials get under way

- Updated 17:10 14 September 2011 by **Michael Marshall**
- Magazine issue 2829.

Volcanic ash inspires sunshade (Image: Arctic Images/Corbis)

Update 14 September 2011: *The field test will be conducted at an abandoned airfield in Sculthorpe, UK. Matthew Watson of the University of Bristol, UK, presented details of the project at the British Science Festival in Bradford, UK.*

Original article, posted 9 September 2011

FIELD trials for experiments to engineer the climate have begun. Next month a team of UK researchers will hoist one end of a 1-kilometre-long hose aloft using a balloon, then attempt to pump water up it and spray it into the atmosphere (see diagram).

The water will not affect the climate. Rather, the experiment is a proof of principle to show that we can pump large quantities of material to great heights. If it succeeds, a larger-scale version could one day pump sulphate aerosols into the stratosphere, creating a sunshade that will offset the greenhouse effect.

The trial, led by Matthew Watson of the University of Bristol, UK, is part of a £2 million project called Stratospheric Particle Injection for Climate Engineering (SPICE). Funded by two UK research councils, it also aims to find out the ideal particles to use in an atmospheric sunshade and will attempt to model their effects in greater detail than ever before. The test is not alone: a string of other technologies that could be used to "geoengineer" our environment are being field-tested (see "Coping with emissions").

In his blog, *The Reluctant Geoengineer*, Watson argues that we need to investigate the effects of sulphate aerosols as a last-resort remedy should the climate start to change rapidly. Researchers contacted by *New Scientist* agreed with Watson that such research should continue, if only to find out whether the techniques are feasible. "I'd say there's a 50-50 chance we'll end up doing it, because it'll get too warm and people will demand the planet be cooled off," says Wallace Broecker of Columbia University in New York. But there was less enthusiasm for SPICE's approach to the problem.

There are "large gaps" in our understanding of geoengineering, says Thomas Stocker of the University of Bern in Switzerland. Stocker helped to organise an expert meeting on geoengineering in June for the Intergovernmental Panel on Climate Change. It identified key unanswered questions that should be a focus for research. However, it is not clear that field trials like Watson's will provide the answers.

One area of doubt over injecting aerosols into the stratosphere is whether it will change the behaviour of high-altitude clouds. That could in turn affect the climate in ways beyond what was intended - and for now, we don't know how, or how much. Aerosols could also deplete the ozone layer, contribute to air pollution and may alter visibility in the same way as large volcanic eruptions can.

The SPICE test won't answer any of these questions, says David Keith of Harvard University. "I think it's a little reckless." The most interesting result will be how the public reacts, he says.

What's more, Keith adds, in the long run delivering sulphates to the stratosphere with a hose would be a bad idea. Spraying aerosols locally allows the particles to clump together, making them less effective at reflecting sunlight and more likely to be swept down by rain (*Environmental Research Letters*, DOI: 10.1088/1748-9326/4/4/045108).

Keith's own studies suggest that if we were ever forced to try to screen out some of the sun's rays globally, it would be more effective to spray sulphuric acid from aircraft (*Geophysical Research Letters*, DOI: 10.1029/2010GL043975).

It would also be cheaper, costing a few billion dollars a year according to a study by Aurora Flight Sciences, an aeronautical firm in Cambridge, Massachusetts. Such figures are tiny compared to the trillions that the consequences of climate change could cost the global economy if emissions continue to rise at current rates.

The point, says Ken Caldeira of the Carnegie Institution for Science in Stanford, California, is that experiments like Watson's, which test relatively simple delivery systems, address the issue of cost. But, since the Aurora study has shown that cost is not a critical factor - a sunshade will be relatively inexpensive - the critical questions relate to potential risks.

More importantly, since a stratospheric sunshade is intended to have a global impact, all countries must agree to such a project and to its precise extent, which is unlikely to happen.

One possibility that may help countries agree is that the sunshade need not be applied evenly across the globe. Caldeira has created, in a climate model, a sunshade with much larger quantities of aerosols above the poles than above the tropics. This produced a temperature distribution much closer to the pre-industrial climate than

could be achieved with a uniform sunshade (*Environmental Research Letters*, DOI: 10.1088/1748-9326/5/3/034009).

Caldeira and others are now toying with the idea of regional geoengineering, or "geoadaptation". Some techniques, such as making clouds over the seas more reflective, should have localised effects, so countries could in theory tinker only with their own climate.

But here too uncertainties need to be resolved. Gavin Schmidt of the NASA Goddard Institute for Space Studies in New York points out that changes in one area will have a knock-on effect on the other side of the planet. "What happens in Vegas does not stay in Vegas," he says. We could perhaps predict these long-range effects, but we cannot eliminate them.

Schmidt says that what we need is not field tests, but better modelling studies. Most simulations of geoengineering are "naive", he says, and cannot model all the possible side effects. "People are not doing the right kinds of experiments to assess these effects," he says.

Additional reporting by Catherine Brahic

Coping with emissions

THE pipe-to-the-sky experiment is not the only geoengineering method that is being tested.

In 2009, a team of Russian scientists sprayed a small amount of sulphate aerosols into the atmosphere and found that they blocked between 1 and 10 per cent of incoming solar radiation (*Russian Meteorology and Hydrology*, DOI: 10.3103/S106837390905001X).

Iceland is testing a less contentious technique to deal with our carbon emissions: turning them into rock. The CarbFix project aims to capture carbon dioxide from a local geothermal power plant, dissolve it in water and inject it into basalt rock, where it will react with magnesium, calcium and iron to form carbonates. If it works, the CO_2 should stay put even in an earthquake. It is the safest way of storing CO_2, according to project leader Sigurður Reynir Gíslason of the University of Iceland in Reykjavik. The team plans to start the gas injections later this month.

Adding iron to the ocean can trigger plankton blooms that suck up CO_2, but a 2009 field test gave mixed results. That's because the test site was unsuitable, says Richard Lampitt of the National Oceanography Centre in Southampton, UK. He and colleagues hope to repeat the trial.

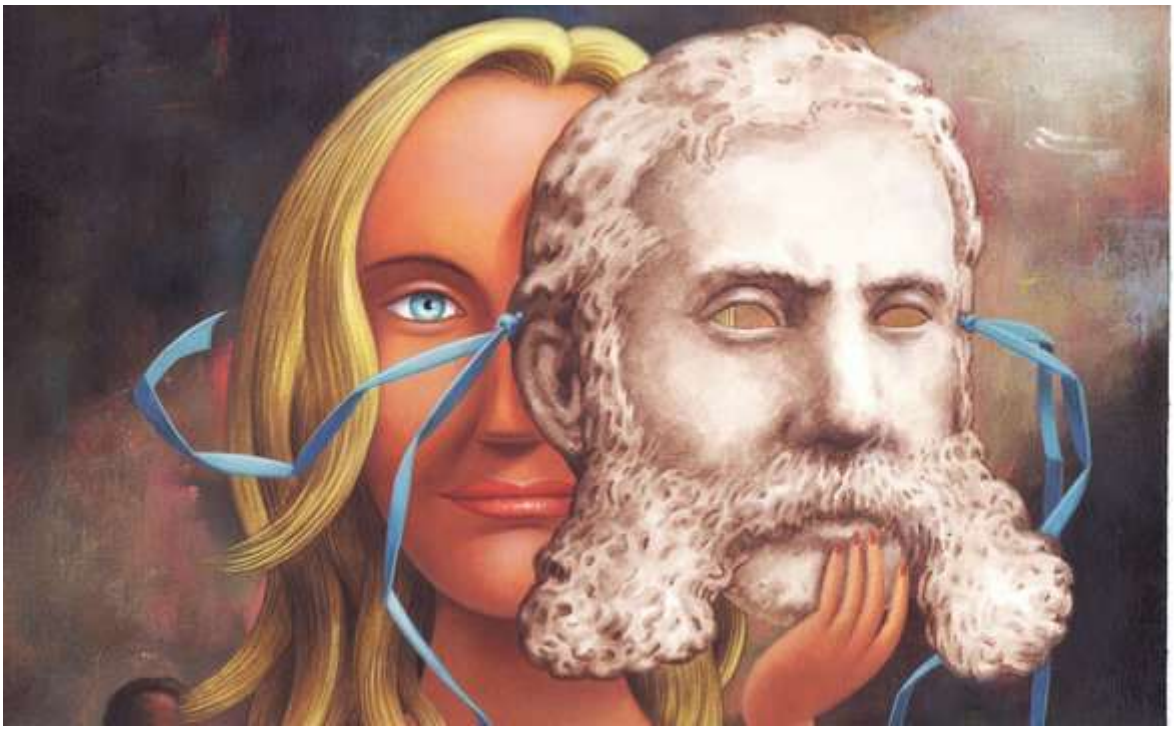
Elsewhere, Ken Caldeira of the Carnegie Institution for Science in Stanford, California, has permission to add sodium hydroxide - an alkali - to a small patch of ocean to see if it can reverse the effects of ocean acidification.

Finally, California-based engineer Armand Neukermans is building a nozzle that will spray seawater into clouds, making them whiter and better able to reflect sunlight into space.

http://www.newscientist.com/article/mg21128294.000-geoengineering-trials-get-under-way.html

The Guggenheim Connection

By GRAHAM BOWLEY



Insu Lee

LADY CATARINA PIETRA TOUMEI and her benefactor, David B. Guggenheim, late of the New York Guggenheims, will never rank among the great impostors. Victor Lustig sold the Eiffel Tower. Anna Anderson masqueraded as Anastasia. David Hampton posed as the son of Sidney Poitier, snookering high-caste Manhattan.

Lady Catarina and Mr. Guggenheim (David Birnbaum, of Ditmas Park, Brooklyn, in court records) played for the grand name of Guggenheim, and they didn't get far. They were arrested earlier this year, along with Vladimir Z. Guggenheim — in truth, Vladimir Zuravel, a massage therapist from Moldova — and accused of trying to swindle American investors out of billions of dollars.

Even in this post-Madoff era, their caper stands out for its chutzpah. The picture painted by authorities is a tabloid monument to financial fakery, replete with whispers of rare diamonds, Iraqi oil, connections to the Chinese Politburo and even to American presidents. Capping it all were supposed assurances from the Guggenheims, one of the nation's richest and most famous families.

In hindsight, the whole affair seems so preposterous it is hard to imagine anyone could have gotten away with it. But, online and in person, the faux Guggenheims were so convincing that, for a moment, a few big-money types almost bit. Even now Mr. Zuravel insists that Mr. Birnbaum, described as a frail man of 68, is a real Guggenheim.

The three have said they are innocent. The criminal charges against Mr. Birnbaum were dismissed on Sept. 9, apparently because prosecutors failed to file a timely indictment, though they could file new charges against him. Ms. Toumei is scheduled to appear Monday morning in the federal courthouse in Lower Manhattan.

What makes the case even more intriguing is that the three were unmasked by the real Guggenheims, who are themselves trying to capitalize on the family name in ways the dynasty's patriarch, Meyer Guggenheim, could not have imagined when he arrived from Switzerland in 1848 to seek his fortune in America.

Meyer Guggenheim amassed his wealth in mining and smelting. One of his seven sons, Benjamin, went down with the Titanic. As time went on, the family abandoned its early pursuits for the rarefied realms of philanthropy. Another of Meyer's sons, Daniel, was a patron of Charles Lindbergh and endowed aviation research. Still another, Solomon, built the art collection that gave rise to the Solomon R. Guggenheim Museum in Manhattan. A granddaughter, Peggy Guggenheim, became known as much for her private life for as her art collection. The Picassos, Miros and Giacommettis in her palazzo in Venice draw thousands of visitors a year.

But in 2000, a great grandson of Meyer Guggenheim, Peter Lawson-Johnston Sr., decided that it was time for the Guggenheims to get back to work. With $30 million of family money, he helped found Guggenheim Partners, a boutique financial company modeled on the Wall Street partnerships of old.

Whether this Lilliputian investment company could take on the giants of global finance was anyone's guess. The odds were certainly long. But its early success is turning some heads on Wall Street, particularly given tough financial times. In recent years, as the great investment houses have cut back, Guggenheim Partners has hired roughly 1,700 people, leveraging a name that is often mentioned in the same breath as Carnegie, Rockefeller and Vanderbilt. It is opening a high-octane trading unit and has tried to muscle in on the lucrative mergers-and-acquisitions business. Today, its money management division oversees $120 billion in assets, only a small portion of which is Guggenheim family money.

To help lead these ventures, Guggenheim Partners has hired Alan D. Schwartz, the smooth deal maker who tried to right Bear Stearns before it collapsed into the arms of JPMorgan Chase, foreshadowing the financial shocks to come. Others have signed on from the likes of Goldman Sachs and Merrill Lynch.

So no one was more surprised than the executives at Guggenheim Partners when two men purporting to be Guggenheims and fronted by a charming woman calling herself Lady Catarina offered to sell $1 billion in diamonds from a private Guggenheim collection that, in fact, didn't exist.

And not only diamonds. Ms. Toumei — known to her associates as a countess — apparently tried to coax the Coca-Cola Company into a deal involving "Guggenheim" vodka. She invited Rupert Murdoch to dinner (he never got back to her) and tried to court the Bush family. There was talk of gold, of Swiss banks, of loans to the tiny African nation of Swaziland — on and on.

In a letter to one commodities trader, dated May 28, 2010, Ms. Toumei said David and Vladimir Guggenheim were prepared to buy $1 billion to $3 billion of crude oil. "This is not so unusual of a request when you consider that Mr. Guggenheim owns several refineries abroad," she wrote.

The letter, on Guggenheim letterhead and signed Lady Catarina Pietra Toumei, included a reference to the legitimate Guggenheim Partners, as well as Internet addresses of various Guggenheim museums and foundations.

David E. Cummings, a general partner at the Dolphin Capital Group in Pittsburgh, says he spoke to Ms. Toumei by telephone about diamonds, art, gold and other investments. An art aficionado himself, he was tempted by the Guggenheim name, and by her smooth pitch.

"It looked real," he says. "She talked the talk."

Ms. Toumei's lawyer, Jan Ronis, says the episode amounted to little more than a thrill-seeking fantasy. No one lost any money, he says. "It has been difficult for me to figure out what crime, if any, was committed," he says. "The three were engaged in writing exciting e-mails to important people."

At Guggenheim Partners, people simply shook their heads.

THIRTY-TWO blocks south of the Guggenheim Museum in Manhattan is another shrine to the Guggenheim fortune. In the ninth-floor offices of a skyscraper near Bloomingdale's are mementoes of a gloriously rich past: a sketch of Meyer Guggenheim and his sons; a three-foot-long bar of copper from the Chuquicamata mine in Chile; a check for $70 million, dated 1923, for the sale of two million shares of the Chile Copper Company to the Anaconda Copper Mining Company.

In a glass case is a golden trophy from the 1953 Kentucky Derby. It was won by Dark Star, a stallion owned by one of Meyer's grandsons, Harry F. Guggenheim, who with his third wife, Alicia Patterson, established Newsday in 1940.

These artifacts adorn the offices of Guggenheim Partners. The idea behind this business was to turn Guggenheim Brothers, the investment firm that had quietly tended the family's fortune, into a full-fledged financial services company. Today the family is no longer the biggest stakeholder. Another wealthy clan, the Sammons of Texas, owns even more of it than the Guggenheims.

But it is clear that one name — Guggenheim — counts here. "You read about the Guggenheim family, and there are a lot of great values associated with that family consistent with what we want to be as a firm," says Mr. Schwartz, flanked by Mark R. Walter, the C.E.O., and Todd Boehly, president.

Mr. Walter, 51, is an affable Iowan and a member of a Guggenheim foundation and the board of the Guggenheim Museum. Mr. Boehly, 37, previously managed Guggenheim money at another firm.

"The name means a lot," Mr. Schwartz says of the Guggenheims, whose wealth is now spread among hundreds of descendants.

Only one of Meyer's descendants, Peter Lawson-Johnston Jr., plays a day-to-day role in the business. A fresh-faced man of 54, he splits his time between the office in Manhattan and another in Connecticut, advising on real estate and generally playing ambassador to potential clients. ("He is a brand steward for us," Mr. Walter says.)

On this June morning, Mr. Lawson-Johnston is regaling a delegation from Bahrain about his family's history.

Guggenheim Partners and its related businesses, he says, arose because the family wanted to make its money work harder. "We were unhappy with the service we were getting from some of our advisers," he says.

The firm initially focused on managing money for the wealthy, and it has made some savvy moves. Before many on Wall Street caught on to the frauds at Enron, Tyco and WorldCom, Guggenheim was steering clients away. "We recommended selling Enron very early on," Mr. Boehly says.

What they never expected was that one day a con might involve the Guggenheim name.

An unassuming red-brick building on the bustling Ocean Parkway in Brooklyn seems an unlikely manse for an heir to Gilded Age riches. But there in the lobby, near the doorbell for one of the apartments, is the name Guggenheim. Another name is listed for the same apartment: Birnbaum. A man who answered the bell one Friday morning earlier this month said Mr. Birnbaum wasn't home.

Exactly how David Birnbaum of Brooklyn became David B. Guggenheim, scion of the Guggenheims, is unclear. His tale, like so many others, seems to have taken life on the Internet. Mr. Zuravel apparently met Mr. Birnbaum at a Brooklyn synagogue and was convinced that Mr. Birnbaum was for real. After Mr. Zuravel later connected on Facebook with Ms. Toumei, the three went to work.

To the world — indeed, even to Mr. Zuravel — Ms. Toumei, 46, was Lady Catarina. The honor, she claimed, was bestowed by certain crowned heads of Europe in recognition of her charitable works. She came across as an aristocrat, at least over the phone and on e-mail. She often signed off her notes with a quotation from Winston Churchill: "We make a living by what we get, we make a life by what we give."

In reality, Ms. Toumei was a sometime journalist with a long résumé and a home in Rancho Sante Fe, Calif. At one point, according to prosecutors, she claimed to be the wife of John Ratzenberger, the actor who played Cliff Clavin on "Cheers." (A spokeswoman for Mr. Ratzenberger said the two had a short-lived relationship.)

Mr. Zuravel says Ms. Toumei told him that she had business connections that could help Mr. Birnbaum — that is, David Guggenheim. Mr. Birnbaum's lawyer declined to comment. Ms. Toumei's lawyer said she wasn't available.

As crazy as all of this might sound, a few fish rose to the bait.

On Dec. 15, 2010, the C.E.O. of an international project management company traveled to New York to meet the man he knew as David B. Guggenheim. The goal was to close a deal involving Iraqi crude and a Chinese oil refinery. The men met in the lobby of the apartment building on Ocean Parkway and, later, according to prosecutors, talked over dinner about a Guggenheim estate in Westchester County and the oil markets and the military industry. A few days later, Mr. Birnbaum called the executive, who is not named in the court documents. The caller ID read Birnbaum, not Guggenheim.

The jig was up.

Back in Pittsburgh, Mr. Cummings had connected with Ms. Toumei online and by telephone but was growing suspicious. Why, he wondered, did this Guggenheim have a foreign accent, given that the real Guggenheims have been in America since the 19th century?

"Do you have a lawyer? Do you have an investment banker?" he asked.

"No, we do our own deals," he was told.

Mr. Cummings had met Ms. Toumei through Robert K. Goodwin, the chief executive of RKG Energy, an commodities trading business in Fairfax, Va., who had heard her name around the industry and connected via Facebook.

"Robert, I am answering your Facebook message," Ms. Toumei replied to one of Mr. Goodwin's messages. "Are you a buyer or seller of petro?"

Mr. Goodwin is a former president of the Points of Light Foundation, which was started by President George H. W. Bush — a fact that Ms. Toumei quickly seized on.

"I can at any time — 24/7 (except for the Sabbath) — get Mr. David B. Guggenheim on the phone to speak with either President Bush," she wrote to Mr. Goodwin.

Later, she asked Mr. Goodwin to pass along this message to the Bushes: “Mr. David B. Guggenheim is a major shareholder of six of the top international banks, and a majority owner of China National Petroleum (along with the Chinese government). Additionally, Messrs. Guggenheim are large contributors to Home Land Security and the U.S. Army.”

Mr. Goodwin declined to put her in touch with the Bushes.

Ms. Toumei later wrote to Mr. Cummings, on Guggenheim letterhead, saying the family was “ready, willing and able to supply you with up to 100,000 carats worth of rough diamonds according to your needs: 5 carats+, 10 carats+, or 20 carats+. These are the highest quality stones.”

Wait a minute, Mr. Cummings thought. “There is something wrong here,” he replied. “The amount of diamonds here is more than DeBeers sells. How is this possible?”

Ms. Toumei, he said, assured him that the Guggenheims were severing their ties with DeBeers and liquidating the diamonds in their vast private collection.

Mr. Cummings asked for something in writing. “One more try — else, we walk!” he wrote in an e-mail. “For GOD’s sake this is a potential $1B deal/transaction and you are sending me grade school material from a Solomon Guggenheim descendant and family member: Wear my shoes!”

He said he was told that if he put $5 million down he would get all the verification he needed.

“The alarm clock went off,” Mr. Cummings says. He called Guggenheim Partners.

LIKE other boutique investment firms — Rothschild, say — Guggenheim Partners isn’t attacking the Wall Street giants head-on.

“We are not certainly about taking on Goldman Sachs or Morgan Stanley,” says Scott Minerd, the chief investment officer. Neither is Guggenheim taking on money management titans like BlackRock or Pimco, he says.

“The flip side is there is a lot of different areas that we can fill in the holes on,” he says. “We are different. We don’t have a lot of one-size-fits-all products.”

Consider the new proprietary trading business, Guggenheim Global Trading. It will be housed on a 30,000-square-foot trading floor being built in Purchase, N.Y. The plan is to invest an initial $500 million — and, as other banks downsize and lay off people, scoop up some talent.

The most audacious hope is to become a full-scale broker-dealer — and a thorn in the side of the Goldmans and the Morgans of the world.

Mr. Schwartz, for one, is happy to be here. “They were a very entrepreneurial family throughout the years,” he says of the Guggenheims. “They found opportunities through innovation. That is the whole history of this firm.”

Mr. Minerd and other executives say Guggenheim Partners saw the financial collapse of 2008 coming and urged its clients to shift into safe investments like United States Treasury securities.

"We hunkered down for it," Mr. Minerd says. Unlike some other Wall Street players, Guggenheim didn't bet big against the mortgage market. "But then, our clients are not looking for us to make them rich but to keep them rich."

The crisis brought in new asset management business as insurance firms ran into trouble and they or their regulators approached Guggenheim for help.

That led to two big transactions: the purchases of Security Benefit of Kansas and Standard Life of Indiana. The crisis also gave Guggenheim executives confidence that they could succeed in the long term, as grand old names like Lehman Brothers and Bear Stearns disappeared, and others, like Merrill Lynch, were subsumed into bigger banks.

LAST FEBRUARY, Ms. Toumei stepped out of the federal courthouse in Lower Manhattan and into a media scrum. The tabloids were feasting on the tale of the ersatz Guggenheims. Lady Catarina departed — dressed, according to The Daily News, "in a stylishly tight black dress and high heels" — proclaiming she was "innocent until proven guilty."

Mr. Goodwin says he found Ms. Toumei "articulate, energetic and intriguing." He continues: "I don't know whether she was a co-conspirator or herself a victim." So, looking back, it is hard to know who may have conned whom.Mr. Zuravel says he never even met the countess. But he would like to. "She is a great person," he says.

As for Mr. Birnbaum, Mr. Zuravel says he remains convinced that he is a true Guggenheim. "He is a Guggenheim, but the family don't want any kind of competition," Mr. Zuravel says.

"Nobody knows who is a real Guggenheim," he says. "Nobody knows who is a Guggenheim."

http://www.nytimes.com/2011/09/18/business/the-guggenheim-connection-fame-riches-and-a-masquerade.html?ref=design

The unsung sense: How smell rules your life

- 19 September 2011 by **Catherine de Lange**
- Magazine issue 2830.

Exquisite sense *(Image: Brian Stauffer)*

Smells shape our moods, behaviour and decisions, so why do they barely register in our conscious lives?

I TRY to forget about potential onlookers as I crawl around a central London park, blindfolded and on all fours. With a bit of luck, the casual passer-by might not notice the blindfold and think I'm just looking for a contact lens.

In fact, I'm putting my sense of smell to the test, and attempting to emulate the sensory skills of a sniffer dog. Just as a beagle can swiftly hunt down a pheasant using only its nasal organ, I am using mine to follow a 10-metre trail of cinnamon oil.

Such a challenge might sound doomed to failure. After all, dog noses are renowned for their sensitivity to smells, while human noses are poor by comparison. Yet that might be a misconception. According to a spate of recent studies, our noses are in fact exquisitely sensitive instruments that guide our everyday life to a surprising extent. Subtle smells can change your mood, behaviour and the choices you make, often without you even realising it. Our own scents, meanwhile, flag up emotional states such as fear or sadness to those around us. The big mystery is why we aren't aware of our nasal activity for more of the time.

Noses have certainly never been at the forefront of sensory research, and were pushed aside until recently in favour of the seemingly more vital senses of vision and hearing. "There has been a lot of prejudice that people

are not that influenced by olfactory stimuli, especially compared to other mammals," says Lilianne Mujica-Parodi, who studies the neurobiology of human stress at Stony Brook University in New York.

One of the first people to assert the relative unimportance of human smelling was Pierre Paul Broca, an influential 19th-century anatomist. After comparing the proportion of the brain devoted to smell in different animals, he suggested that mammals can be classed into two broad groups: macrosmatic mammals, such as dogs, have a finely tuned sense of smell which they rely on to perceive the world, while we, along with other primates and the marine mammals, are microsmatic - we have a small and functionally redundant olfactory apparatus.

That idea seemed to fit with more recent studies in genetics, which found that the majority of mammals have genes coding for about 1000 different types of smell receptor. Most of these genes aren't expressed in humans, giving our noses just 400 different types of receptor (see chart).

Yet these findings may have been misleading. Brain scans now show that more of the brain is devoted to smell processing than Broca's anatomical studies would have suggested. And although we may have fewer types of receptor than other mammals, Charles Greer at Yale University has shown that the human nose and brain are unusually well connected, with each group of receptors linking to many more neural regions than is the case in other animals. That should give us a good ability to process incoming scents.

Once researchers began looking, they found the nose to be far more sensitive than its reputation suggested. One study, for example, found that we can detect certain chemicals diluted in water to less than one part per billion. That means that a person can detect just a few drops of a strong odorant like ethyl mercaptan in an Olympic-sized pool.

We are also exceptionally gifted at telling smells apart, even distinguishing between two molecules whose only difference is that their structures are mirror images of one another (*Chemical Senses*, vol 24, p 161). "That is fantastic sensitivity," says George Dodd, a perfumer and researcher at the olfaction group of the University of Warwick, UK.

What's more, it is becoming clear that the brain's olfactory centres are intimately linked to its limbic system, which is involved in emotion, fear and memory. That suggests a link between smell and the way we think.

The power of smell will be no news to estate agents, who often advocate the smell of baking bread or brewing coffee to promote the sale of a house. But there are more subtle and surprising effects too. For instance, when Hendrick Schifferstein from Delft University of Technology and colleagues pumped the smell of orange, seawater or peppermint into a nightclub, the revellers partied harder - they danced more, rated their night as more enjoyable, and even thought the music was better - than when there was no added scent (*Chemosensory Perception*, vol 4, p 55). Rob Holland and colleagues at the University of Utrecht in the Netherlands, meanwhile, have found that the hint of aroma wafting out of a hidden bucket of citrus-scented cleaner was enough to persuade students to clean up after themselves - even though the vast majority of them hadn't actually registered the smell (*Psychological Science*, vol 16, p 689).

Other work has found that scent can influence our cognitive skills. A study this year by William Overman and colleagues at the University of North Carolina Wilmington found that when men were subjected to a novel smell - either good or bad - during a gambling task used to test decision-making skills, they performed significantly worse than normal. The researchers conclude the scent stimulated brain areas connected with emotion, making their decisions emotional rather than rational (*Behavioral Brain Research*, vol 218, p 64). Smells also seem to direct our visual attention, and they may play a key role in consolidating memories too (see "Blast from the past").

Our sense of smell may even help us to pick up on the emotional state of those around us. This idea has been highly controversial, but work by Mujica-Parodi suggests we can sense another's fear from their sweat. At the time, she was working on a way to assess a person's vulnerability to stress, and needed a reliable way to scare her subjects, without socially loaded words or pictures that might mean different things to different people. That's hard to do, says Mujica-Parodi: "You can't mug somebody in a scanner."

Freak out

The answer came from nature. Rats are known to be able to smell each other's fear, leading them to "freak out" if placed in an empty cage in which another rat has just seen a predator. Mujica-Parodi figured humans might do the same thing. To test the idea, her team took sweat samples from people doing a skydive for the first time. When they presented the samples to unrelated subjects in an fMRI scanner, they saw activation of the amygdala - the brain area that normally lights up in studies of emotion. This did not happen when sweat samples came from the same skydivers pounding a treadmill.

Mujica-Parodi's team next tested whether the smell of fear sweat affected people's responses to various facial expressions - angry, ambiguous or neutral. Normally, we would pay more attention to angry faces, because they pose a threat, but after smelling the fear sweat, the participants gave all three types the same attention (*Social Cognitive and Affective Neuroscience*, in press, DOI: 10.1093/scan/nsq097). "It forced the brain to pay attention to things that otherwise it wouldn't consider worth its time," Mujica-Parodi says.

The smell of fear may be just one of many olfactory signals emitted by the human body. Another study this year, by Yaara Yeshurun at the Weizmann Institute in Rehovot, Israel, and her team found that the imperceptible smell of women's tears decreases sexual arousal in men (*Science*, vol 331, p 226). "It's a way of giving power to females, to make men less attracted to them," she says. The role of scent, or pheromones, in sexual attraction remains controversial, however.

The surprising thing about these studies is that few of the subjects were aware of the smells that they were facing, yet their behaviour was altered nevertheless. The question, then, is why we pay so little conscious attention to our noses unless we get a whiff of something truly pungent?

Lee Sela and Noam Sobel, also at the Weizmann Institute, blame our obliviousness on two factors. Firstly, they point out that our noses just aren't equipped to locate the source of an odour. This makes the sense of smell fundamentally different to vision or hearing, which are built to pinpoint sights and sounds and turn them into a mental map. According to one leading theory of consciousness, we become aware of something when the brain's "attentional spotlight" focuses on a single location, after which it picks out the fine details, like a familiar face, from the scene. With such a poor map of smells, the spotlight can't shine on any particular part of the smellscape and make us aware of the details, say Sela and Sobel. It's for this reason that we can only ever pick out around four smells from a complex mixture, they say.

The other reason centres on a phenomenon called change blindness, which was first found to influence our vision. In 1999, Kevin O'Regan from the Laboratory for the Psychology of Perception in Paris, France, and colleagues found that people can miss even large changes to a visual scene when those changes are accompanied by an interruption, such as a camera cutting to a different viewpoint in a film (*Nature*, vol 398, p 34). They argued that the cut provides a fleeting distraction which means the change goes unnoticed. Since then, change blindness has been demonstrated in hearing and in touch.

Sela and Sobel think that smell could be next on the list. They point out that our sniffs are full of gaps as we breathe in and out, which could make it difficult for us to notice new odours wafting around - even if we do react to them subconsciously (*Experimental Brain Research*, vol 205, p 13).

It's an interesting idea, says O'Regan, but he's not yet convinced. In particular, he is critical of the suggestion that sniffing more quickly would dissipate the effect. "Even if you were going to sniff very quickly you would still have a break between each sniff." In visual change blindness, even the subtlest of cuts can mask large changes, he says.

There are other ways that we can improve our noses, though. "We all have the capacity to train our sense of smell," says Dodd, "but you have to work at it." Master perfumers, for instance, learn to recognise, name and imagine an extraordinary range of smells through years of training. This is accompanied by a significant reorganisation of the olfactory areas that helps them to process the scents more efficiently (*Human Brain Mapping*, in press, DOI: 10.1002/hbm.21207).

Jess Porter and colleagues at the University of California, Berkeley, have also been trying to train people's noses. They persuaded 32 students to wear blindfolds and ear defenders, and get down on all fours to see whether they could sniff out a trail of chocolate oil.Intrigued, I wanted to try it for myself, which is how I ended up on all fours in a London park.

My first attempt didn't go well - there seemed to be so many smells competing for my attention, including damp soil, grass and cigarette butts. But, like the majority of the participants in Porter's experiment, I did manage to follow the trail to the end on the subsequent attempts, even when it deviated off a straight path. For Porter's volunteers, repeated practice over three days brought greater accuracy and speed.

Of course you don't have to crawl on the grass to train your nose. Any attempt to consciously pay attention to what your nose is telling you should have some benefit. And even if you choose to ignore it entirely, there's no getting away from the fact that, behind the scenes, your nose is working overtime to make you who you are. That's one discovery that's not to be sniffed at.

Blast from the past

Smells are especially good memory evokers, but it's actually a myth that odours trigger more detailed memories than other stimuli. "The memory is not more accurate and you don't remember more details," says Yaara Yeshurun at the Weizmann Instititute of Science in Rehovot, Israel, "but it is unique in that it is more emotional." This isn't surprising when you consider that there are certain brain areas dedicated to both emotion and olfaction, such as the amygdala, and there is a strong link between emotion and memory.

That said, not all smell memories are created equal. In 2009, Yeshurun found that the link between a memory and a smell is stronger if the smell is an unpleasant rather than a pleasant one, which makes sense from an evolutionary perspective. She also discovered that the very first time we associate a smell with an object, it evokes a much greater response in our brains than for any subsequent encounter with the smell or object, laying down stronger foundations for the memory. That doesn't happen with any other sense. Since those first encounters with a smell would have happened at a young age, this might explain why smells often transport us back to our childhood.

Lost and found

Molly Birnbaum only realised the extent of her injuries from a car accident when she was at a family gathering a few weeks later. Her stepmother had baked an apple crumble. "It wasn't until she held it under my nose and I breathed in that I realised I could not smell a thing." Her doctors believe the impact she experienced must have disconnected the nerves between her nose and brain.

Without smell, Birnbaum knew her dreams of becoming a chef were over. What soon became clear, however, was that the loss also dulled her overall perception of the world. "It was as if the texture of my environment was wiped smooth," she says.

There was some hope for the future, however, since nerves can sometimes regenerate. To help them, she began by smelling spices from her cupboard for 10 minutes a day, before setting off on a more serious quest, picking up tips from some of the world's top perfumers and chefs. Slowly but surely, the nerves grew back and her sense of smell returned. In doing so, she experienced the strong link between smell and mood - during bouts of depression, she struggled to smell, but in happier times smells came back.

"Smell is one of the more important ways of understanding the world around us," she says. "It's just unfortunate that sometimes you have to lose something to understand how important it is."

Catherine de Lange *is a freelance journalist based in London*

http://www.newscientist.com/article/mg21128301.800-the-unsung-sense-how-smell-rules-your-life.html

Reputation and Monolith, Both Stand Tall

By RANDY KENNEDY

Konrad Fiedler for The New York Times

A 3,500-pound, 12-foot-tall column made of solid cast polyester resin, one of De Wain Valentine's most ambitious pieces, on display at the J. Paul Getty Museum.

GARDENA, Calif.

THE studio of the sculptor De Wain Valentine sits here anonymously amid 1970s-era shopping strips deep in the suburban savannah south of Los Angeles, sharing a parking lot with a dental ceramics manufacturer. On a recent walk around the property Mr. Valentine, 75, peered in at some of his dental neighbors, laboring silently in lab coats and paper face masks, and told a visitor: "I like to see those guys. Maybe they'll let me trade one of my pieces for some bridgework if I ever need it."

The sculptures that Mr. Valentine has made over the last four decades — quasi-religious incarnations of coastal light and air made from some of the most sterile, synthetic materials ever produced by American industry — are not exactly low-end bartering chips. They have been showing up with increasing regularity in prestigious Chelsea and Los Angeles exhibitions, and last year one of his early pieces, from 1966, was acquired by the Museum of Modern Art, where its now commands the middle of a room devoted to Minimalism.

But for many years it seemed as if Mr. Valentine's name had slipped off the list of artists celebrated for forging a distinctly West Coast version of Minimalism in the 1960s and '70s, and that his work had been relegated to a kind of period curiosity. One of his most ambitious pieces was long thought to be lost: a pair of 3,500-pound towers made of solid cast polyester resin, imperious 12-foot-tall monoliths that ended up (for reasons beyond Mr. Valentine's control) residing ignobly on their sides, looking a lot like elevator lobby screens, in the headquarters of the medical-supply company in Deerfield, Ill., that commissioned them in 1975.

Now, as part of Pacific Standard Time — the sprawling multi-museum event opening throughout Southern California in the late summer and fall to re-examine the history of postwar Los Angeles art — both that lost work and Mr. Valentine are being, in a very real sense, rediscovered.

If anyone seems to serve as the symbol of Pacific Standard Time's ambitions — shared by more than 60 institutions — to bring underappreciated West Coast artists into the historical spotlight, it is Mr. Valentine.

Last week the J. Paul Getty Museum opened "From Start to Finish: De Wain Valentine's 'Gray Column,' " an exhibition centered on one of the resin monoliths. His work is also being featured in shows at three other museums as part of the event, in addition to a large survey exhibition at the Getty, whose research institute and foundation arm hatched and nurtured the Pacific Standard Time idea.

The "Gray Column" show, which presents the resin sculpture to the public for the first time in the form in which Mr. Valentine intended, turned upright like a looming interplanetary sentinel, did not come to the Getty through normal curatorial channels. It began instead as a project of the Getty's Conservation Institute, a fitting avenue given that in his heyday Mr. Valentine often seemed to be as much a materials scientist as an artist, one of the most daring pioneers in the use of substances previously unheard of for art making: fiberglass, Plexiglas, cast acrylic, polyester resin.

As a child in Colorado he developed an appreciation for color and surfaces, spending time with his miner uncles and scavenging copper and iron ore from tailing piles, the rocks and gravel left by the mining process. He worked in boat shops and began to make art pieces from plastic, which he tried unsuccessfully to show in New York. "The galleries would look at my slides and say: 'Oh my, that's lovely! What is it made out of?' And I'd say, 'Plastic,' and that was that," Mr. Valentine recalled in an interview. "It wasn't something one made art out of apparently."

Giving the other coast a shot in 1965, he arrived in Los Angeles at just the right time. Artists like Larry Bell, Peter Alexander, Craig Kauffman and Helen Pashgian were in the early stages of creating the spare, luminous aesthetic that came to be known as the Los Angeles Look or Finish Fetish. (The latter term was wielded by critics as an insult, much as the words Baroque and Impressionist once were, though after so many years it has come to acquire an air of connotative cool.)

The look was defined by a kind of holy union between the sleek synthetic materials then becoming available from booming postwar manufacturing and the panoply of things those artists could mold the materials to evoke and idealize: Pacific sunlight, hot-rod and surfing culture, the airline and aerospace industry, and a kind of Eastern transcendence they seemed to be much closer to than their Minimalist counterparts on the other side of the country.

Mr. Alexander described his early translucent cast-resin works — which grew out of his experience glossing surfboards — as "containers of silence, as if one were underwater." Mr. Valentine spoke of wanting a way "to cut out large chunks of ocean or sky and say: 'Here it is,' " and he came close to finding it in his work.

He took up poured polyester resin, which hardens in a mold, but within a few years he began to yearn to create larger chunks of sea and sky than the properties of the commercially available resin would then allow. And rather than wait for the industry to catch up to his ambitions, he essentially raced past it instead. He developed a close relationship with one of his suppliers, the Hastings Plastics Company in Santa Monica, and in 1970, as a result of his studio experiments, the company introduced a new kind of highly stable resin named for him, Valentine Maskast Resin No. 1300-17, which allowed him and other artists to go far beyond the 50-pound limit to which they had once been restricted.

A 1970 company brochure sang his praises perhaps more loudly than critics of the time did: "It was difficult for Hastings Plastics or any other supplier to believe that an artist has worked out formulas and techniques for casting relatively clear polyester resin pieces in single pours" up to several thousand pounds. It was a breakthrough for cutting-edge sculptors but, as the brochure said, also quite handy for "bar tops, table tops, glazing, stained-glass windows, room dividers, etc."

Mr. Valentine eventually set to work with the new resin on the mammoth paired columns, a commission from the medical-supply company then known as Baxter Travenol for its new headquarters in Illinois. Pictures from the time show him and his assistants in his Venice Beach studio, which could easily have been mistaken

for an explosives factory: the men wear protective suits and face masks, working over huge blue chemical drums, ready with a forklift to shove a piece out the garage door in a hurry if the catalyzing process caused it to become so hot that the wooden mold caught fire.

A few hundred pounds of resin came off during the grueling weeks of sanding and polishing. It was exacting and expensive work. “I didn’t make as much as a grocery store clerk on the whole thing, but I really wanted to build a piece that big,” recalled Mr. Valentine, who now sports a long gray pony tail in place of the bushy beach hair he once wore.

“I’m glad I did it when I was young,” he added. “I thought I was going to live forever and could do anything.”

As he finished the columns, he learned that the ceilings in the room for which the pieces were destined in the company’s headquarters had been lowered, so he reluctantly agreed to install them on their sides, renaming them “Two Gray Walls.” They stayed there for several years; at some point one column toppled against a couch and was damaged. The pieces migrated into storage and finally back into Mr. Valentine’s possession, where they sat for years — unseen, too large to do anything with, too expensive to restore — and there they would probably have remained.

This is where Tom Learner came in. He runs the Modern and Contemporary Art Research program at the Getty Conservation Institute. The institute has become a leader in the growing field of conserving 20th- and 21st-century art made from complex, tricky industrial materials, and Mr. Valentine’s work seemed to provide a veritable petri dish of research possibilities. Then, as a result of the Pacific Standard Time project, the conservation interest quickly broadened into a plan to rescue the undamaged column from storage and base an entire exhibition around it and the story of its creation.

For Mr. Valentine, whose health has slowed his productivity in recent years, probably the most satisfying aspect of the piece’s revival has been the simplest and least expected: over more than three decades, he had never once seen the work standing upright. (It had been molded, finished and shipped on its side.) But several weeks ago he walked into the gallery at the Getty Museum where the column now rises, its deep gray gradually dissolving into a ghostly, colloidal translucence as it tapers toward its top.

“It changes so much depending on the light, the time of day, even just the way you look at it,” he said later. Asked what he thought when he saw it, he smiled, leaned in and whispered, “Wowee zowee.”

“People ask me what color it is,” he said, “and I just say, ‘Magic.’ ”

http://www.nytimes.com/2011/09/18/arts/design/de-wain-valentine-at-pacific-standard-time-in-california.html?ref=design

Deep impact: The bad news about banging your head

- 14 September 2011 by **Bob Holmes**
- Magazine issue 2829.

Yet another hard knock: Dave Duerson (dark helmet) later killed himself, fearing he had dementia *(Image: Sylvia Allen/NFL/Getty)*

Concussion has long been seen as a temporary and fairly harmless affliction. But the repercussions can last a lifetime

THE two men in the hospital ward had both hit their heads in car accidents, but that was where the similarities ended. One would spend weeks unconscious in critical care, near to death. The other had only a mild concussion; he never lost consciousness, but somehow didn't feel quite right.

Yet months later their roles were reversed. "The one with the severe injury is almost back to normal function," says Douglas Smith, director of the Center for Brain Injury Repair at the University of Pennsylvania in Philadelphia, "and the one with concussion can't go back to work, probably ever."

Smith's two patients illustrate one of the frustrating paradoxes of head injuries: even seemingly mild impacts can have devastating long-term consequences. And we have no way of predicting who will fully recover and who will have lingering problems.

Concussion, or mild traumatic brain injury as doctors call it, has long been seen as a benign and temporary affliction. But over the past decade there has been growing realisation that longer-term symptoms can affect between 10 and 15 per cent of those diagnosed with it. These range from fuzzy thinking and memory lapses to, for the most unfortunate, serious neurological conditions such as premature Alzheimer's disease.

In fact, concussion is thought to be the single biggest environmental cause of Alzheimer's. Even a mild impact can double the risk of developing early dementia, according to a massive study of older military veterans in the US, which was presented at the Alzheimer's Association International Conference in July (bit.ly/pDhlHJ). In that, the risk jumped from 7 to 15 per cent.

It now appears that concussion is not a single, discrete event, but can be the beginning of a degenerative disease lasting weeks, months or longer. "It is an injury that can keep on taking," Smith says. As details of that process emerge, researchers are beginning to identify where its progression might be blocked. And the advent of new brain scanning techniques may some day let us identify people in the emergency room who are most at risk of long-term problems.

If the research lives up to its promise, that would be good news for us all. The most common causes of concussion are falls and car or bike accidents, and we face an estimated 1 in 4 chance of sustaining a concussion in our lifetime.

That's not the only reason research into concussion is getting record levels of funding. On the battlefield, mild traumatic brain injury has been dubbed the signature injury of service in Iraq and Afghanistan, affecting up to 40 per cent of soldiers who see combat duty. One of the biggest threats to soldiers stationed in these countries is from roadside bombs, often improvised from cast-off artillery shells or other weapons. The introduction of better body and vehicle armour means more soldiers than ever are surviving such blasts, but are left with concussion and other serious injuries.

Then there are the hundreds of thousands of people with sports-related concussions each year, most of whom never go to hospital. This group is especially worrying, since many players of contact sports like rugby, American football or ice hockey experience repeated concussions, and evidence is growing that these serial injuries can heighten the risk of severe brain degeneration years or even decades later.

The risk for athletes is getting increasing attention, particularly in the US, where 75 retired American footballers recently sued the National Football League for doing too little to protect players from the effects of repeated concussions. And the media has jumped on cases such as that of former American footballer David Duerson, who committed suicide last year fearing dementia was setting in. Duerson was careful to shoot himself in the chest, not the head, so that scientists at the Boston-based Center for the Study of Traumatic Encephalopathy could examine his brain. Sure enough, Duerson's autopsy revealed telltale signs of brain deterioration, though it has not yet been proven that these changes caused his symptoms.

One reason it has taken so long to understand concussion is that a blow to the head can cause many bad things to happen to the brain, including bleeding, swelling and the death of nerve cells. With all this chaos going on, it has been difficult to unpick which problems are the most important.

Nor is there a standard way to image the brain to gauge the severity of concussion. "If you fall on your leg and it hurts, we can take an X-ray, and it really helps us decide what to do," says Jeffrey Bazarian, a neuroscientist at the University of Rochester Medical Center in New York state. "We don't have something like that for concussion."

Leaky neurons

For a long time we have suspected that the fibres, or axons, of nerve cells may be particularly vulnerable to concussive blows. "A neuron is like a big, long spaghetti strand with the cell body at one end. This makes it very susceptible to stretch," says Bazarian. "When the head gets struck, the head rotates on the neck, and the brain rotates inside the skull. All those spaghetti strands get stretched."

Back in the 1980s, researchers thought that axon damage occurred only after the most severe impacts, because it was seen in the brains of people who had died from their injuries. Gradually animal studies began to point to damage occurring from milder blows too, although direct evidence about what happens in humans was still lacking.

That is now changing thanks to more sensitive forms of brain scanning. One in particular, known as diffusion tensor imaging (DTI), is especially valuable. Developed only within the past few years, this technique tracks the movements of water molecules in the brain. Normally they move predominantly along the length of the axons. After a blow to the head, however, water also moves laterally, a sign that stretching has made the axons leakier.

The worst of this stretch damage occurs to axons in the brain's frontal lobes, furthest from the axis of rotation at the neck, according to unpublished DTI studies led by Jamshid Ghajar, a neurosurgeon and president of the Brain Trauma Foundation in New York City. This could explain why people with concussion experience problems concentrating and planning actions - key functions of the frontal lobes - rather than, say, loss of vision or movement control, which are handled in other parts of the brain.

This idea also explains why animals are less susceptible to concussion than people: animal brains are too small to experience the same forces. "If you're in the front seat of your car with your dog next to you, and you're in an accident, you might lose consciousness for 5 minutes," says Smith. "When you wake up, your dog is licking you. That's because his 60-gram brain doesn't experience the deformation that your 1500-gram brain does."

The immediate effects of axon stretching are fairly well understood. The axon surface is studded with molecular channels designed to transport sodium or calcium ions into the axon when the neuron fires an electrical signal. When the axon is stretched, these ion channels are pulled open and the ions flow in, sparking a storm of electrical activity.

In response, nerve cells frantically pump the ions back out again. This rapidly depletes the brain's store of energy - especially since the calcium influx chokes off the mitochondria, the cells' energy source. The result is that the brain suddenly flips from overactivity to a state of exhaustion that can last for several days.

This exhaustion may help to explain why athletes are prone to repeat concussions shortly after returning to play. Indeed, more than three-quarters of athletes who experience repeat concussions in a single season incur the second within 10 days of the first, according to a study by Michael McCrea, director of brain injury research at the Medical College of Wisconsin in Milwaukee (*Journal of the American Medical Association*, vol 290, p 2549). And the second injury is often worse, McCrea adds. "If you pile a second injury on top of the first one, before the brain has fully recovered, that's not good."

If this short-lived leakiness and exhaustion were all that happened after a concussion, people should recover completely once its effects had passed - and that is what happens in most cases. But for some it is the beginning of a longer, more serious disease process in which nerve cells continue to degenerate. In unpublished work, Ghajar used DTI to track the health of people who had experienced mild brain injuries. He found that axon damage was initially confined to the frontal lobe. But in those who still had symptoms one

year later, the damage had spread to other regions of the brain that were not affected initially. "I think it's a domino effect," says Ghajar. "The question is: why?"

Answers are now beginning to emerge. For one thing, the initial influx of calcium ions leads to local inflammation. Also, even mild injuries can cause long-term problems with the sodium channels.

Using isolated rat axons stretched by a puff of air, Smith's team has shown that the cells respond to a single gentle stretch by adding more sodium channels within hours of the injury. "What we suspect is that although the stretch injury was mild, it still disrupted the sodium channels enough that more were needed," says Smith. The extra channels may make it easier to restore normal ion flow after the injury, but they also make the cells leakier after a second injury (*Journal of Neuroscience Research*, vol 87, p 3620).

Stretching can also damage an axon's internal structure, especially the microtubules that transport molecules around the cell. The microtubules behave like Silly Putty, says Smith - when pulled gradually they stretch smoothly, but when jerked suddenly they become brittle and can snap. If that happens, it's like breaking a train track: all the microtubules' cargo derails at the break. When this happens in an axon, which it seems to after a blow to the head, the long-term consequences can be dire.

That's because one of the main cargoes within axons is a molecule called amyloid precursor protein, which helps to regulate connections betwen nerve cells. When APP piles up at the site of a microtubule break, it is broken down into a smaller protein, amyloid beta. This can accumulate within the axons and has also been found aggregated into fibrous plaques within the brain, presumably after being released from dying cells.

These amyloid plaques are all too well known - they are a hallmark of Alzheimer's and other degenerative brain diseases. In Alzheimer's, amyloid beta causes changes to another protein known as tau, which also forms tangled plaques. Tau tangles also turn up in people who have had repeated concussions, notes Mark Burns, a neuroscientist at Georgetown University in Washington, DC.

The usual suspects

The sequence of events in Alzheimer's is not exactly the same as what happens after head injury. In particular, the amyloid plaques appear to be temporary, not permanent, after head injury, and the tau plaques tend to occur deeper within the brain in Alzheimer's than after a head injury, says Burns. But the fact that the same two proteins are suspects in both sorts of brain disease suggests a new lead to follow.

Indeed, Burns has more direct evidence linking amyloid beta to brain injury. His team delivered mild-to-moderate brain injuries to mice, then tested their ability to walk along a 6-millimetre-wide beam. Uninjured mice can do it relatively easily, but injured ones can no longer muster the necessary coordination. "They'll go from about five mistakes per 50 steps to 50 mistakes," says Burns. Three weeks after injury, the mice have regained a little of their coordination, but still average 40 to 45 mistakes per 50 steps.

But when Burns gave mice a drug that blocks the production of amyloid beta, they recovered far more quickly, making just 25 mistakes per 50 steps after three weeks (*Nature Medicine*, vol 15, p 377). A different drug - one that helps the body clear away unwanted amyloid beta instead of preventing its formation - also speeded up the mice's recovery, Burns's team reported earlier this year (*Journal of Neurotrauma*, vol 28, p 225).

All this suggests that amyloid beta and perhaps tau are involved in the dementia that sometimes follows concussion. If so, then drugs to block the amyloid beta cascade may speed up recovery from concussion and ward off at least some of its long-term effects in people too. Much testing remains before this could happen,

of course, but if they prove safe enough, such drugs could be given routinely after a concussion as a preventative measure.

Burns is not the only researcher with promising potential therapies to treat axon injury. Earlier this year Ramona Hicks, who directs the brain injury repair programme at the US National Institute of Neurological Disorders and Stroke in Bethesda, Maryland, convened a workshop to review axonal injury and its treatment.

Though no therapies are yet ready for clinical use, Hicks is optimistic that our growing understanding of brain injury, and our increasing ability to peer into the injured brain with advanced imaging technologies like DTI, should yield much progress in the next few years. If so, the day may come when physicians will know in the emergency room which concussed patients are at greatest risk of complications and begin treatment to prevent them. That way athletes, blast-shocked soldiers and those who are simply unlucky enough to fall in the street will have a greater chance of complete recovery.

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http://www.newscientist.com/article/mg21128291.800-deep-impact-the-bad-news-about-banging-your-head.html

The Future, Retrenched

By PHILIP NOBEL

Jan Bitter

WHAT may be the biggest architecture event of the year ahead has not yet been scheduled. But when it happens, it'll be a doozy: MGM Resorts International recently announced its intention to demolish the Harmon, a tower by Norman Foster that is a prominent component of the new CityCenter development in Las Vegas. Construction flaws were found years ago, and the building was never completed or occupied. Still, the spectacle of a boom-time project by one of the world's most celebrated designers razed by a controlled implosion is sure to spark talk about the state of architecture today.

The fate of Mr. Foster's building is a timely metaphor. Institutional work, with its longer project timelines and steadier financial supply, is continuing apace through the recession. Some ambitious commercial plans, like the development of the West Side rail yards in Manhattan, are moving forward. But the days of true extravagance, exemplified by CityCenter and its collection of flashy buildings by big-name architects, is over for now, in Western nations at least.

The months to come will offer few grand openings of the kind that merit front-page coverage and spotlights on the street. Most major projects that were in the construction pipeline before the 2008 financial crash have either been completed or indefinitely postponed; ambitious new buildings, like the crop of 1,000-foot-plus towers planned for or under construction in Midtown Manhattan, are years away.

Preston Scott Cohen's interesting new building for the Tel Aviv Museum of Art, important as the first major work of a theorist who has garnered a lot of critical attention in recent years, may stand out as something of an exception, even an anachronism, when it opens on Nov. 2. So too may the Military History Museum in Dresden, Germany, designed by Daniel Libeskind as a brutal insertion into an existing structure and set to be unveiled on Oct. 14. Renzo Piano's large but sensitive addition to the Isabella Stewart Gardner Museum in Boston is scheduled to open its doors on Jan. 19, but Mr. Piano's light modernist touch is less likely to invite comparisons to the past decade's architectural excesses in the way Mr. Libeskind's and Mr. Cohen's museums, with their more aggressively convoluted forms, seem ready to.

As they are completed in the months to come the many buildings under construction for next summer's Olympic Games in London may turn the conversation back to formal experimentation in the building arts. Until then there is a reprieve. We are starting to see a natural turn toward substance, an interest in engagement with the world via architecture — and examinations of architecture's place in the world — that goes beyond daring structural innovation or crowd-pleasing surface effects.

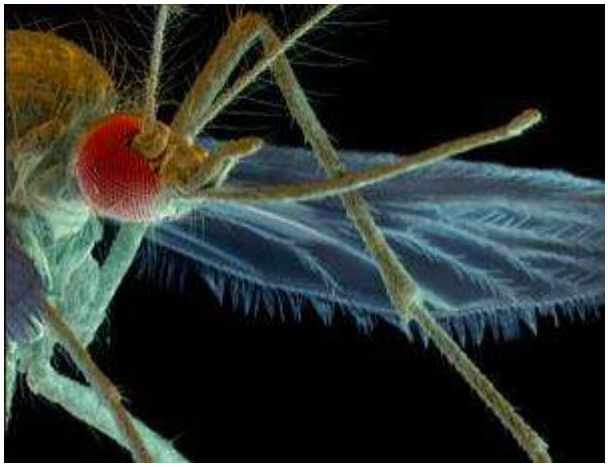
In April the Museum of Modern Art in New York announced an initiative to research architectural responses to the foreclosure crisis, in partnership with the Temple Hoyne Buell Center for the Study of American Architecture at Columbia University. Five interdisciplinary teams have been imagining better-built futures for the country, and the resulting projects will be shown in an exhibition, "Foreclosed: Rehousing the American Dream," opening on Feb. 14.

The Canadian Center for Architecture in Montreal seems to be moving along similar salutary lines. "Imperfect Health," organized by Giovanna Borasi and Mirko Zardini, is a look at how the architecture of our cities contributes to pollution, anxiety and illness. The show opens on Oct. 25. Those wishing to know more about the state of architecture in our uncertain times should mark the entire month of October on their calendars. Archtober, a program coordinated by the Center for Architecture and the New York chapter of the American Institute of Architects, will fill the city next month with exhibitions, film screenings, tours and lectures on our buildings, our cities and where we might go from here.

http://www.nytimes.com/2011/09/18/arts/design/architectures-future-retrenched.html?ref=design

Swarm troopers: Mutant armies waging war in the wild

- 12 September 2011 by **Henry Nicholls**
- Magazine issue 2829.



Warning: mosquitoes may contain a genetic time bomb (Image: David Scharf/Science Faction/Getty)

We can now genetically modify animals to kill off their own kind, while leaving other species unharmed

IN THE urban jungle of Juazeiro in Brazil, an army is being unleashed. It is an army like no other: the soldiers' mission is to copulate rather than fight. But they are harbingers of death, not love. Their children appear healthy at first but die just before they reach adulthood, struck down by the killer genes their fathers passed on to them.

These soldiers are the first of a new kind of creature - "autocidal" maniacs genetically modified to wipe out their own kind without harming other creatures. The first animals being targeted with these "living pesticides" are disease-carrying mosquitoes and crop-munching caterpillars, but the approach should work with just about any animal - from invasive fish and frogs to rats and rabbits. If it is successful, it could transform the way we think about genetically engineered animals.

In essence, much the same method has already been successfully employed for more than half a century. In the so-called "sterile male technique", large numbers of the target pest are bred, sterilised and the males let loose. When they mate with wild females, the resulting eggs are not viable, so releasing enough sterile males can eventually exterminate wild populations.

Infographic: Compare the sterile insect and autocidal techniques

This method is widely used and has notched up many successes. For instance, it helped to eliminate the screwworm fly from the US and other areas - the fly's larvae burrow into the flesh of livestock and even people. It also helped clear the tsetse fly from Zanzibar.

And it is not limited to insects: a similar approach is being used to try to control an invasive parasitic fish in the American Great Lakes. Male lampreys are being trapped, chemically sterilised and released.

The sterile male technique has the huge benefit of being incredibly focused, homing in only on the species you want to control. Pesticides, by contrast, harm a wide range of other species, including us.

So why isn't the method more widely used? The main problem is that it is very difficult to sterilise animals without harming them in other ways. The usual way of sterilising insects is to zap them with radiation, for instance, which leaves the males weakened. Establishing the optimal dose of radiation for a species is thus crucial - too little and fertile insects will be released, too much and the males will be too feeble to compete for females. Working out the optimal dose is best done in the field, but the task is laborious without an easy way to distinguish sterilised insects from wild ones.

Enter Oxitec, a biotechnology company based just outside Oxford in the UK. It has created a pink bollworm - a moth caterpillar - with a built-in fluorescent marker called DsRed. The bollworm is a major pest in cotton fields, and in 2002 an eradication campaign was launched in the US, part of which includes releasing sterilised bollworms. In 2006, Oxitec's fluorescent bollworm became the first genetically engineered animal to be deliberately released into the environment. Over three years of successful trials, more than 20 million moths have been released in the US so far.

These modified moths are just the start. When the founder of Oxitec, Luke Alphey, first learned about the sterile insect technique from a colleague in the 1990s, he realised that the molecular tools he was using in his everyday research might provide a better alternative. Within a matter of years, he had created fruit flies with genes that kill their offspring (*Science*, vol 287, p 2474).

In theory, unlike zapping animals with radiation or chemosterilisation, the genetic approach should work well with just about any species. Besides the pink bollworm, Oxitec is targeting the mosquito *Aedes aegypti*, the single most important carrier of dengue, a viral disease that affects 50 to 100 million people in tropical regions every year, including a few in Florida and Queensland, Australia. Usually the symptoms are mild, but around 1 in 20 people become seriously ill. There is no vaccine and no treatment, so the only way to combat the disease is to kill the mosquitoes that carry it - and they are becoming resistant to pesticides.

Alphey and his colleagues have created a strain of *A. aegypti* with two copies of a gene that disrupts the development of offspring. The gene is switched off in the presence of the antibiotic tetracycline, allowing large numbers of perfectly fit mosquitoes to be bred for release. "With our system, the mosquitoes are fundamentally sterile and we're keeping them alive by giving them an artificial antidote," says Alphey. The insects also have the DsRed marker gene, to enable them to be easily monitored.

When these mosquitoes mate with wild females, the eggs hatch and the larvae develop normally until they reach the pupae stage, when the killer genes kick in. Delaying death like this is actually a cunning trick: the doomed larvae compete with wild larvae for resources, further reducing their numbers.

In 2009, Oxitec began a series of field trials of this strain of *A. aegypti* in the Cayman Islands in the Caribbean, making it the first engineered mosquito to be let loose in the wild. The trial showed that the engineered mosquitoes survive and disperse from the site of release, and compete well for mates.

With the Oxitec mosquitoes accounting for just under 20 per cent of all males in the population, around 10 per cent of the eggs produced contained the engineered genes. "We got about half as many transgenic offspring as you would have expected had everything been equal," he says. "But this is way more than you need for success." The mosquitoes also performed well in a small trial in Malaysia, says Alphey.

Now a bigger trial is getting under way in Juazeiro, Brazil, which Alphey hopes will be scaled up into a full-scale control programme. In the meantime, Oxitec has been busy developing other, more sophisticated strains, including one particularly devious one.

With both the classical sterile-insect method and the genetic variations on it, it is normally vital to release just males. If you release males and females at the same time, they will mate with each other, reducing the impact upon the wild population. Unfortunately, separating the sexes takes a lot of time and effort in some species. "This is a huge problem if there is a need to release millions of males per week," says Mauro Marelli, an epidemiologist at the University of São Paulo, Brazil, who is working with Oxitec on the trials in Juazeiro.

With the tsetse fly, for instance, separation by hand is common. Separation is much easier with *A. aegypti*, as the female pupae are quite a bit bigger than the male pupae. Nevertheless, the process still requires dedicated facilities at the release site, which makes it expensive. Transporting adults is not feasible. "Adult mosquitoes are all spindly and if you pack them into any kind of space, you end up with legs tangled up with wings and a lot of physical damage," says Alphey.

Instead, his team has created a strain in which the females cannot fly. The work was based on the discovery that female mosquitoes have a unique flight muscle protein that males lack, perhaps because females have to fly after a blood meal and so must fly with a much heavier load. Flightless females cannot find people to feed on and cannot mate either, so there is no need to separate the sexes. Envelopes containing millions of eggs could simply be mailed to wherever they are needed. "Just add water and you get instant mosquitoes," says Alphey.

The males that hatch from the eggs will appear normal and can pass the flightless gene to their daughters. Their sons will also inherit a single copy, so they too will produce some flightless daughters. "The construct will persist in the population for several generations but not for long due to its high fitness cost," says Alphey.

Oxitex also has malaria-carrying mosquitoes in its sights, but this is a greater challenge than dengue. For a start, there is often more than one malaria-carrying mosquito species responsible for transmission in a particular area, so effective control would mean targeting each these species separately. In addition, malarial mosquitoes often bite other animals besides humans, so their distribution is less predictable than *A. aegypti*'s.

For malaria then, this kind of technology is unlikely to be as effective as for dengue but it could still be helpful. "It'll turn out to be extremely valuable in some places, a piece of the jigsaw puzzle in other regions and perhaps not that relevant in other areas," says Alphey.

While Oxitec is leading the way, many other groups around the world are working on similar approaches - and not just for killing insects. "On technical grounds, there's no reason why the logic of sterile insects could not be transferred to vertebrates," says Ronald Thresher, an ecologist working for Australia's national scientific agency, CSIRO.

He thinks the autocidal approach could not only be used to control invasive species such as cane toads, but that it is the only method that could work in many cases. "It's the only hope we have for the long-term control and eradication of these pests," he says. "Other efforts help, but in the end they are Band-Aids in the absence of a real solution."

Thresher has come up with a way to create fish that produce only male offspring. Releasing enough of these "daughterless" fish into the wild, with each passing on the daughterless habit, would turn a thriving invasive population into a bunch of reluctant bachelors destined for extinction.

His method relies on the fact that an enzyme called aromatase is crucial for generating female hormones in fish. Switch off the aromatase gene and you've created a fish that can only produce sons. He has shown the approach works in lab tests on zebrafish, skewing the sex ratio in favour of males for at least three generations. The plan is to tackle carp, an invasive fish blamed for the decline in native fish species and the erosion of riverbanks across the vast Murray-Darling river basin in south-east Australia.

Models suggest that releasing enough daughterless carp to make up 5 per cent of the total population would effectively eradicate carp in the Murray-Darling basin by 2030.

Thresher's models also suggest pests such as cane toads and rats could be tackled this way. However, breeding large animals is labour intensive. "So the expense of such a programme quickly becomes an issue," says Thresher. Public acceptance could also be a huge issue, Alphey points out. "A large number of adult male rats - sterile or not - is probably not the way you want to go."

Eco-friendly

Nevertheless, if autocidal technology lives up to its promise, it could be about as environmentally friendly as pest control can get. It could largely or entirely replace pesticides, and it affects only the target species. Last but not least, it is hard to see what could go wrong.

Many engineered plants, for instance, are being given advantageous traits such as disease resistance, so these genes could well spread among wild relatives. Autocidal traits, by contrast, are a great disadvantage and should disappear from the wild within a few generations after releases stop. "We are putting genes with huge, huge fitness penalties like death into something that's undesirable in the first place," says Alphey.

In theory, wild insects might be able to evolve resistance, for instance, by somehow learning to recognise and avoid insects with lethal genes. But this is much less likely to develop than pesticide resistance, and could be overcome by altering the release strain.

Needless to say, those opposed to genetic engineering are not convinced. "Genetic modification leads to both intended and unintended effects," says Ricarda Steinbrecher of EcoNexus, which describes itself as "a not-for-profit, public interest research organization". "There are potential knock-on effects on many other organisms," she claims.

Most biologists, though, agree the risks are minimal. "It is true that some of the regulations are being put together as the programmes are moving along, but the risks are really very, very small," says Mark Benedict, an entomologist at the University of Perugia in Italy. For him, the big question is whether it is a cost-effective approach.

The risks also have to be weighed against the potential benefits. Dengue, for instance, is spreading rapidly in the tropics. There are promising vaccines in trials and several potential antiviral candidates, but engineered mosquitoes are potentially a very powerful way of preventing the disease, says Jeremy Farrar, director of the Oxford University Clinical Research Unit in Ho Chi Minh City in Vietnam. "We need to really push the developments, be hard-nosed about assessment of what works, and ensure that what does work gets implemented."

Much could ride on the success or failure of autocidal technology. So far, most GM organisms have offered few visible benefits to consumers. Opposition to their use remains widespread, particularly in Europe. But if they are seen to save lives by helping control pests and diseases, opinions could change.

That could open the door to other, even more ambitious genetic approaches to pest control. One that has particular promise exploits chunks of "selfish" DNA that can spread themselves through the population and kill only when two copies are inherited. In theory a one-time release of just a few insects, rather than the continual release of millions, could wipe out a wild population (*New Scientist*, 22 March 2003).

Success could also change people's attitude to genetic engineering more widely. "Our aim is to reduce the burden of dengue in vulnerable populations," says Alphey, "but if this helps promote a more nuanced discourse about genetic technology in general, that would certainly be a welcome side effect."

***Henry Nicholls** is a freelance writer based in London and author of The Way of the Panda (Profile, 2010)*

http://www.newscientist.com/article/mg21128291.700-swarm-troopers-mutant-armies-waging-war-in-the-wild.html

In a Married World, Singles Struggle for Attention

By TARA PARKER-POPE

Stuart Bradford

Here's a September celebration you probably didn't know about: It's National Single and Unmarried Americans Week.

But maybe celebration isn't the right word. Social scientists and researchers say the plight of the American single person is cause for growing concern.

About 100 million Americans, nearly half of all adults, are unmarried, according to the Census Bureau — yet they tend to be overlooked by policies that favor married couples, from family-leave laws to lower insurance rates.

That national bias is one reason gay people fight for the right to marry, but now some researchers are concerned that the marriage equality movement is leaving single people behind.

"There is this push for marriage in the straight community and in the gay community, essentially assuming that if you don't get married there is something wrong with you," says Naomi Gerstel, a sociologist at the University of Massachusetts in Amherst who has published a number of papers comparing the married and unmarried.

"But a huge proportion of the population is unmarried, and the single population is only going to grow. At the same time, all the movement nationally is to offer benefits to those who are married, and that leaves single people dry."

Yet as she and other experts note, single people often contribute more to the community — because once people marry, they tend to put their energy and focus into their partners and their own families at the expense of friendships, community ties and extended families.

In a report released this week by the Council on Contemporary Families, Dr. Gerstel notes that while 68 percent of married women offer practical or routine help to their parents, 84 percent of the never-married do. Just 38 percent of married men help their parents, compared with 67 percent of never-married men. Even singles who have children are more likely than married people to contribute outside their immediate family.

"It's the unmarried, with or without kids, who are more likely to take care of other people," Dr. Gerstel said. "It's not having children that isolates people. It's marriage."

The unmarried also tend to be more connected with siblings, nieces and nephews. And while married people have high rates of volunteerism when it comes to taking part in their children's activities, unmarried people often are more connected to the community as a whole. About 1 in 5 unmarried people take part in volunteer work like teaching, coaching other people's children, raising money for charities and distributing or serving food.

Unmarried people are more likely to visit with neighbors. And never-married women are more likely than married women to sign petitions and go to political gatherings, according to Dr. Gerstel.

The demographics of unmarried people are constantly changing, and more Americans are spending a greater percentage of their lives unmarried than married. While some people never marry, other adults now counted as single are simply delaying marriage longer than people of their parents' generation did. And many people are single because of divorce or the death of a spouse. About one-sixth of all unmarried adults are 65 and older; nearly one-eighth of unmarried people are parents.

The pressure to marry is particularly strong for women. A 2009 study by researchers at the University of Missouri and Texas Tech University carried the title "I'm a Loser, I'm Not Married, Let's Just All Look at Me." The researchers conducted 32 interviews with middle-class women in their 30s who felt stigmatized by the fact that they had never married.

"These were very successful women in their careers and their lives, yet almost all of them felt bad about not being married, like they were letting someone down," said Lawrence Ganong, a chairman of human development and family studies at the University of Missouri.

"If a person is happy being single," he said, "then we should support that as well."

Bella DePaulo, a visiting professor of psychology at the University of California, Santa Barbara, has a term for discrimination against single people, which she calls one of the last accepted prejudices. It is the title of her new book, "Singlism: What It Is, Why It Matters and How to Stop It."

As an example, Dr. DePaulo cites the Family and Medical Leave Act. Because she is single and has no children, nobody in her life can take time off under the law to care for her if she becomes ill. Nor does it require that she be given time off to care for a sibling, nephew or close friend.

Stephanie Coontz, director of research for the Council on Contemporary Families, says policy makers often neglect the needs of single people because their view is outdated — based on the way they themselves grew up.

In researching her latest book, “A Strange Stirring: The Feminine Mystique in American Women at the Dawn of the 1960s,” Ms. Coontz found that in the past single people were often called “deviant,” “neurotic” and “selfish.”

“We do have the tendency to think that there is something special about married people, and that they are the ones who keep community and family going,” she said. “I thought it was important to point out that single people keep our community going, too.”

http://well.blogs.nytimes.com/2011/09/19/the-plight-of-american-singles/?ref=health

Brainy molluscs evolved nervous systems four times

- 15:53 16 September 2011 by **Ferris Jabr**

I evolved it my way *(Image: Jeff Rotman/Nature Picture Library/Rex)*

Slimy and often sluggish they may be, but some molluscs deserve credit for their brains – which, it now appears, they managed to evolve independently, four times.

The mollusc family includes the most intelligent invertebrates on the planet: octopuses, squid and cuttlefish. Now, the latest and most sophisticated genetic analysis of their evolutionary history overturns our previous understanding of how they got so brainy.

The new findings expand a growing body of evidence that in very different groups of animals – molluscs and mammals, for instance – central nervous systems evolved not once, but several times, in parallel.

Kevin Kocot of Auburn University, Alabama, and his colleagues are responsible for the new evolutionary history of the mollusc family, which includes 100,000 living species in eight lineages. They analysed genetic sequences common to all molluscs and looked for differences that have accumulated over time: the more a shared sequence differs between two species, the less related they are.

The findings, which rely on advanced statistical analyses, fundamentally rearrange branches on the mollusc family tree. In the traditional tree, snails and slugs (gastropods) are most closely related to octopuses, squid, cuttlefish and nautiluses (cephalopods), which appears to make sense in terms of their nervous systems: both groups have highly centralised nervous systems compared with other molluscs and invertebrates. Snails and slugs have clusters of ganglia – bundles of nerve cells – which, in many species, are fused into a single organ; cephalopods have highly developed central nervous systems that enable them to navigate a maze, use tools, mimic other species, learn from each other and solve complex problems.

Slimy cousins

But in Kocot's new family tree, snails and slugs sit next to clams, oysters, mussels and scallops (bivalves), which have much simpler nervous systems. The new genetic tree also places cephalopods on one of the earliest branches, meaning they evolved before snails, slugs, clams or oysters.

All this means that gastropods and cephalopods are not as closely related as once thought, so they must have evolved their centralised nervous systems independently, at different times.

That's a remarkable evolutionary feat. "Traditionally, most neuroscientists and biologists think complex structures usually evolve only once," says Kocot's colleague Leonid Moroz of the University of Florida in St Augustine.

"We found that the evolution of the complex brain does not happen in a linear progression. Parallel evolution can achieve similar levels of complexity in different groups. I calculated it happened at least four times."

The four groups that independently evolved centralised nervous systems include the octopus, a freshwater snail genus called *Helisoma*, *Tritonia* – a genus of strikingly coloured sea slugs – and *Dolabrifera*, another genus of sea slugs, albeit less aesthetically interesting.

"If these results hold up, it suggests strongly that centralised nervous systems evolved more than once in Mollusca," says Paul Katz, a neurobiologist at Georgia State University in Atlanta. "This is more evidence that you can get complexity emerging multiple times."

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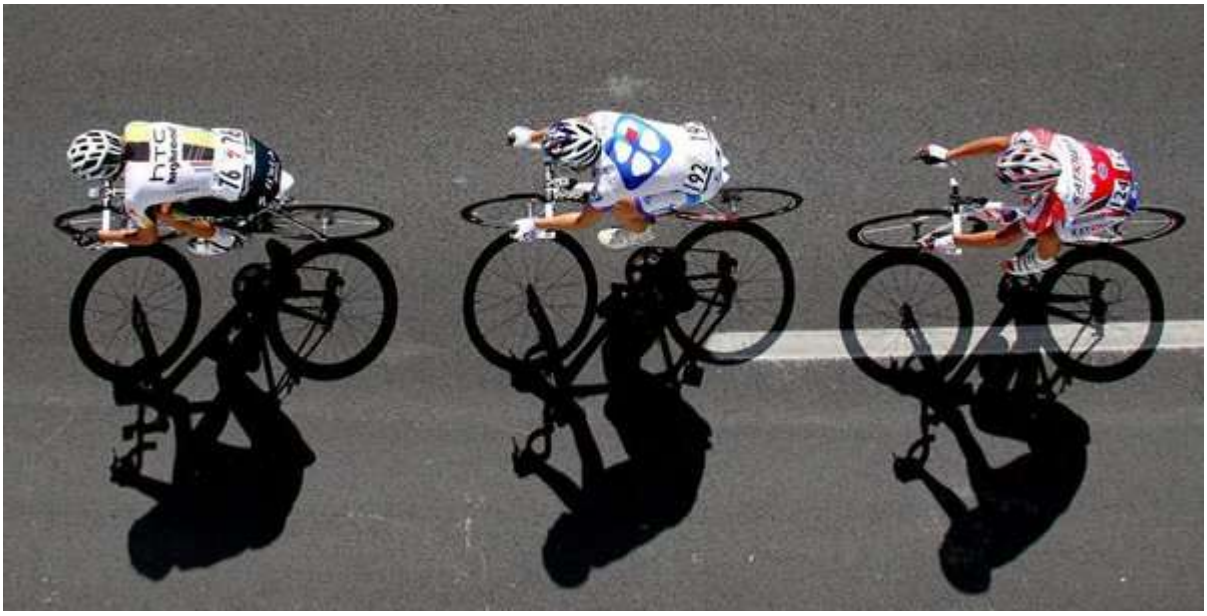
http://www.newscientist.com/article/dn20925-brainy-molluscs-evolved-nervous-systems-four-times.html

A Little Deception Helps Push Athletes to the Limit

By GINA KOLATA



Tom Boland/The Canadian Press, via Associated Press

The trained bicyclists thought they had ridden as fast as they possibly could. But Kevin Thompson, head of sport and exercise science at Northumbrian University in England, wondered if they go could even faster.

So, in an unusual experiment, he tricked them.

In their laboratory, Dr. Thompson and his assistant Mark Stone had had the cyclists pedal as hard as they could on a stationary bicycle for the equivalent of 4,000 meters, about 2.5 miles. After they had done this on several occasions, the cyclists thought they knew what their limits were.

Then Dr. Thompson asked the cyclists to race against an avatar, a figure of a cyclist on a computer screen in front them. Each rider was shown two avatars. One was himself, moving along a virtual course at the rate he was actually pedaling the stationary bicycle. The other figure was moving at the pace of the cyclist's own best effort — or so the cyclists were told.

In fact, the second avatar was programmed to ride faster than the cyclist ever had — using 2 percent more power, which translates into a 1 percent increase in speed.

Told to race against what they thought was their own best time, the cyclists ended up matching their avatars on their virtual rides, going significantly faster than they ever had gone before.

While a 2 percent increase in power might seem small, it is enough to make a big difference in a competitive event that lasts four to five minutes, like cycling for 4,000 meters. At the elite level in sports, a 1 percent increase in speed can determine whether an athlete places in a race or comes in somewhere farther back in the pack.

The improved times observed in his experiment, said Dr. Thompson, are "not just day-to-day variability, but a true change in performance." And they give rise to some perplexing questions.

What limits how fast a person can run or swim or cycle or row? Is it just the body — do fatigued muscles just give out at a certain point? Or is the limit set by a mysterious "central governor" in the brain, as Timothy Noakes, professor of exercise and sports science at the University of Cape Town in South Africa, has called it, that determines pacing and effort and, ultimately, performance?

Until recently, exercise physiologists have mostly focused on the muscles, hearts and lungs of athletes, asking whether fatigue comes because the body has reached its limit.

But athletes themselves have long insisted that mental factors are paramount. Roger Bannister, the first runner to break the four-minute mile, once said: "It is the brain, not the heart or lungs that is the critical organ. It's the brain."

Now researchers like Dr. Thompson are designing studies to learn more about the brain's influence over athletic performance.

For example, Jo Corbett, a senior lecturer in applied exercise physiology at the University of Portsmouth in England, wondered how much competition can affect an athlete's speed. To find out, he asked cyclists to ride as hard and as fast as they could on a stationary bicycle for the equivalent of 2,000 meters. As he rode, each rider was shown an on-screen figure representing the cyclist riding the course.

Then Dr. Corbett and his colleagues told each athlete that he would be racing against another rider hidden behind a screen. The researchers projected two figures on the screen, one the outline of the rider and the other the outline of the competitor.

In fact, the competitor on the screen was a computer-generated image of the athlete himself in his own best attempt to ride those 2,000 meters.

The cyclists rode furiously through the on-screen race. And, as happened in Dr. Thompson's experiments, the cyclists beat their best times, finishing with a burst of speed that carried them to virtual victory by a significant length.

Dr. Corbett said the extra effort, above and beyond what the athletes had previously demonstrated, seems to come from the anaerobic energy system, one that is limited by the amount of fuel stored in muscle. The brain appears to conserve the body's limited fuel to a certain degree, not allowing athletes to work too hard.

But in a race, he said, the brain seems to allow athletes to tap more deeply into energy stores than would ordinarily be permitted. "Competition is able to motivate you to dip further," Dr. Corbett said.

Money, in contrast, does not increase individual performance, Dr. Corbett said — at least, not in research experiments. Physiologists have asked athletes to go as fast as they can on a course and then offered money if the athletes could beat their own best times. They could not.

Still, there must be a limit to how fast an athlete can go, even with the most intense competition or even with deception. In a new study, Dr. Thompson tried to find what that limit is.

He used the same method as before: Cyclists on stationary bikes raced an on-screen avatar going a bit faster than the cyclist's own best time. In one group, the only variable was competition. Cyclists were told that the avatar would be going 2 percent faster or 5 percent faster than the cyclist had ever gone.

The other group was deceived. Each cyclist was told to compete against an avatar that would be moving as fast as that athlete had in his best effort. Actually, the avatar was programmed to race 2 percent harder or 5 percent harder. (A 5 percent increase in power translates into a 2 percent increase in speed, Dr. Corbett said.)

The cyclists in the first group gave up from the start when they knew the avatar would be moving faster than they ever had — even when the avatars were going 2 percent harder than the cyclists' own best times. Instead, the athletes matched their own best efforts.

As had been observed in previous experiments, cyclists in the second group, who were deceived, kept up with their avatars when they were programmed to perform 2 percent harder than each athlete at his best. But 5 percent was just too much: The athletes kept up for about half the race, then gave up.

In the end, their overall pace was no better than it had been in their best effort without the avatar. Some seemed to do even worse than their previous best effort.

"It comes back to the belief system within the athlete," Dr. Thompson said. Within limits, if an athlete thinks a certain pace is possible, he or she can draw on an energy reserve that the brain usually holds in abeyance.

One lesson, Dr. Thompson said, is that coaches can eke better performances out of athletes by means of small deceptions.

When an athlete has reached a plateau, a coach might tell an athlete in a training session that the course distance is slightly shorter than it actually is, for example, or that his or her speed at each interval is slightly slower than it is.

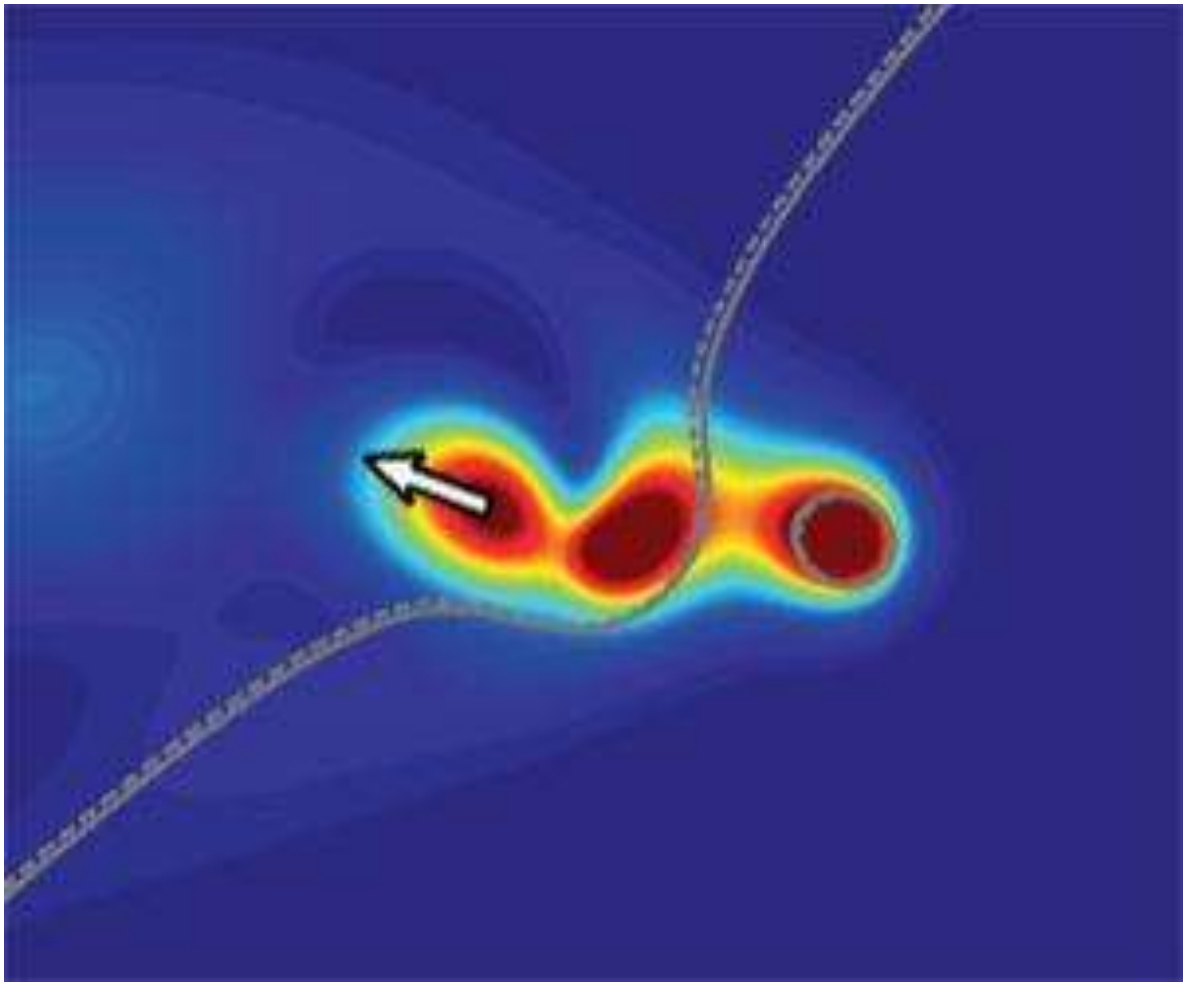
The new research suggests that this strategy may bring about an increase in performance, and Dr. Thompson said that it has been used to coach elite middle-distance athletes, although he declined to provide details.

But it is a risky approach, he added: Even small deceptions can erode the trust between athlete and coach.

http://www.nytimes.com/2011/09/20/health/nutrition/20best.html?nl=health&emc=healthupdateema2

Attoclock turns electrons into movie stars

- 16 September 2011 by **Lisa Grossman**
- Magazine issue 2830.



The Steve McQueen of the subatomic world *(Image: Jila, University of Colorado)*

AN ELECTRON takes just billionths of a billionth of a second to escape its host molecule - mere attoseconds. Now we have the first snapshots of what is the initial step in almost every chemical reaction.

"We can watch not only the atoms and the nuclei in a chemical reaction. Now we can even watch the electrons," says physicist Andreas Becker of the University of Colorado in Boulder. His team, mostly based at Goethe University in Frankfurt, Germany, zapped a molecular hydrogen ion - composed of two protons and one electron, the simplest molecule known - with an ultrafast infrared laser pulse. This booted the electron out of the ion and allowed the researchers to trace the path it took.

It's already possible to make movies of molecules and atoms in motion during chemical reactions using laser strobe lights that flash every few femtoseconds (10^{-15} seconds). However, before two substances can

react, an electron must first make the leap from one atom or ion to another, a process that takes only a matter of attoseconds (10^{-18} seconds).

Laser pulses of 80 attoseconds duration exist and in theory could be used to make a movie of an electron's motion. Becker's team used laser pulses lasting femtoseconds, which are easier to produce. By rotating the pulses once every 1.55 femtoseconds, their pulses tracked motion every 15 to 20 attoseconds, similar to the way the minute hand on a clock tracks minutes, even though it takes an hour to complete one cycle.

The team expected the electron to break free of the hydrogen ion when the laser's electric field was strongest. Surprisingly, the electron made its escape (see the white arrow) 350 attoseconds later. "It changed our understanding of how a molecule is ionised," says Becker. "We thought we understood this process, at least for the simplest molecule." The findings will be published in *Physical Review Letters*.

More work is needed to determine what causes the electron's delay, a first step towards precisely controlling reactions via electron motion, says Becker. "You would like to take an electron and push it where you wish it to go," says attosecond pioneer Paul Corkum of the University of Ottawa in Canada. "That's the ultimate dream."

http://www.newscientist.com/article/mg21128304.200-attoclock-turns-electrons-into-movie-stars.html

Shape memory materials ready for mass production

viernes, 23 de septiembre de 2011 Eureka

Materials that can remember their shape and switch from one form to another may sound like science fiction, they are actually real and already in use all around us. But the alloy used to produce shape memory materials, based on nickel and titanium is expensive. Some researchers have started looking for cheaper options.

Five years ago, Professor Mirko Gojic, a researcher at the University of Zagreb in Croatia, wondered what his small team of researchers could do to lower the price of 'smart metals': a type of high-tech materials that can remember their original cold-forged shape, returning the pre-deformed shape by heating – a property that makes them crucial in a series of industries. The idea was there, but problems quickly aroused from lack of money and key equipment. Thanks to the support of EUREKA, the product is now almost finalised and could be rolled out within the next two years. Gojic thinks that this international research project he led could soon turn into commercial production of a cheaper alloy for use in aerospace engineering or electronics.

Shape memory alloys can be produced to many shapes and sizes for various uses. Although not as strong as steel, they are much more elastic and their properties allow them to adopt the needed shape when exposed to high temperatures. They are used in smart phones, robotics and for medical purposes. For example, nickel-titanium alloy balloons that expand and adapt to the shape of a blood vessel when exposed to body temperatures are used in stent grafts and surgery.

A Team effort

One of the key problems with manufacturing such materials is their high price. Gojic and his team embarked on producing a new, cheaper alloy, based on copper, whereas the most-used alloy is built on a half-half mix of titanium and nickel, known under its trade name Nitinol. 'It is also the most expensive alloy, so there is a lot of effort going into finding an economically viable alternative', says Gojic. The research project called RSSMA, for Rapidly Solidified Shape Memory Alloys, lasted three years.

"We are not the only ones to put our efforts into research on copper alloys, we contributed to the extent of the possibilities offered by our infrastructure and benefited greatly from collaborations with international partners". Trans-border cooperation between R&D partners is one of the pre-requisites to receive financial support from EUREKA.

The Croatian team did not have the facilities to produce the new alloy, but the EUREKA grant allowed them to grow an existing collaboration with colleagues from the Faculty of Mechanical Engineering at the University of Maribor, Slovenia who helped to produce the alloys, which were then tested and examined for their characteristics in Croatia. They also collaborated with colleagues from Montanuniversität Leoben in Austria, and the Faculty of Natural Science and Engineering, University of Ljubljana in Slovenia.

Business-minded R&D

'It is difficult to know exactly how much cheaper the final product will be – it is an important economic parameter to evaluate the success of the project – and it depends partly on techniques used to produce the alloy, but it would certainly be a cost-effective alternative, as titanium and nickel are far more expensive raw materials than copper and aluminium.' Besides the economic requirements, materials used in the production of alloys also have to comply with a certain level of purity and hold specific properties in order to be worthwhile for the industry. 'Tests so far have shown that we are on the right way and we should be able to enter soon in the production phase', Gojic says.

"We have successfully reached the final stages of the research and testing, notably in setting up a process of 'continuous casting', which is crucial for commercial production," he says. "It is important because it allows you to get an important quantity of semi-product, you can make it without interruptions, allowing for mass production, as it is done with other common metallic materials, such as steel."

The Road ahead

The next step will be to pursue research, aiming to have a finalised product within the next one and a half years, followed by the construction of a pilot plant and then finally the take-off of the commercial production. If the next stage of the research goes well it should lead rapidly to the creation of a spin-off pilot firm to manufacture the new alloy. 'This would require more funding and I am considering applying for a further grant that would help us get to the pilot stage, which could then eventually lead to industrial scale manufacturing of the new, cheaper alloy.'

The new alloy has great commercial potential, it would mainly be used in electronics and mechanical industries, since it does not hold the biocompatibility properties of nickel and titanium. It might also find use in the booming market of smartphones and high-tech gadgets. "It would not have been possible for us to improve our knowledge and competencies without EUREKA," Gojic admits.

The grant also allowed the team to put money towards buying new equipment, such as a scanning electronic microscope and equipment for thermal analysis which was important in studying the properties of the alloys developed during the research project. Financing for the new equipment several sources, but the team had to make their own initial investment in order to be granted access to it, and EUREKA allowed them to do so. The team now continues to use this new equipment to develop the project further but also for new research activities in the field of smart materials.

http://www.eurekanetwork.org/showsuccessstory?p_r_p_564233524_articleId=1168240&p_r_p_564233524_groupId=10137

http://www.alphagalileo.org/ViewItem.aspx?ItemId=112953&CultureCode=en

Integrated Solutions

September 23, 2011

In a speech to his campus last week, Southwestern University President Jake Schrum outlined a plan to restructure the university's administration to improve the delivery of services to students and faculty and save money in the long run.

Among the options he proposed was a change to the information technology office and the library. Under the new plan, the departments would be combined into one administrative unit -- a model adopted by dozens of liberal arts colleges over the last 10 years.

While Schrum cited savings -- $250,000 immediately, and more over time -- information officers whose institutions have consolidated said there are significant educational advantages to the new structure. They argue that digitization of research materials, the prevalence of technology in the classroom, and changes in the way students approach information necessitate a change in the way higher education approaches both information storage and technology.

"It's increasingly difficult to see where the demarcations are between IT and library functions," said Bob Johnson, vice president for student and information services and chief information officer at Rhodes College, in Tennessee, which consolidated the offices in the early 2000s. "Customers get better service when there aren't artificial divisions, and you reduce the amount of internal competition and get better at providing services."

Information technology services on many college and university campuses are decentralized, a function of the different roles such technologies play. Some tools are used for teaching and research, others for student services and administration. There has also been little consistency among institutions with regard to the structure of information technology. At some colleges the offices are overseen by academic administrators; at others they are overseen by the financial side of the university. Still others report directly to the president.

Institutions have made various attempts to consolidate disparate IT offices, though most did not include libraries. In the early 2000s, about a dozen liberal arts colleges began folding libraries and IT into one office. Since then, about 50 or 60 more institutions have adopted a unified structure. Most have maintained it, while some, such as the University of Southern California, adopted the model and then abandoned it.

W. Joseph King, executive director of the National Institute for Technology in Liberal Education, located at Southwestern University, has been working with colleges to implement new structures for years. He said libraries and IT are on a collision course. It will soon be hard to think of them as separate entities, he said, so the university structure should reflect that. "You cannot walk into a classroom without seeing a sea of laptops and iPads," he said. "It's clear that digital will be the major means of information access in the future."

But Rachel Applegate, an associate professor of information and library science at Indiana University at Bloomington, argues that just because technology is playing a larger role in research does not necessarily mean it makes sense to have them administered jointly. "The most effective partners for libraries are the faculty," she said. "Being combined with IT means a reporting line that groups you with people who work in the finance area. It separates you from academic affairs.

"When you're reporting through the provost or academic affairs, it means you're at the same table as heads of schools or divisions or academic units when they're discussing curriculum and changes in teaching and learning. You're literally at the table with them."

In merged offices, many roles have remained the same. Archivists' and network engineers' jobs have not changed dramatically, administrators said, but there are areas of overlap between the two divisions that make sense to combine, such as the front lines of student and faculty support.

Johnson said the major benefit of Rhodes's structure is the ability to cross-train individuals in research and information technology assistance to better serve students and faculty. He said administrators found that students often did not know where to go when they had problems and were bringing their questions to the wrong office. Unifying the offices made a one-stop shop for those issues.

Administrators at institutions that have consolidated said they have derived significant savings, but warn that budgetary concerns should not be the main factor behind restructuring. In an article on mergers in *Educause Review*, three university information officers wrote, "[M]erging primarily to save money or reduce staffing will present significant obstacles to success. These motivating factors almost always lead to a downward spiral in service quality and staff morale -- a situation that quickly becomes debilitating. As in the major automation projects experienced by many campus sectors in recent decades, little true financial gain is likely to be harvested in the near term. The real return on investment is realized in the long term, through more effective use of existing resources, increased capabilities, and cost avoidance."

Mike Roy, dean of library and information services and chief information officer at Middlebury College, said the consolidated structure made it easier to shift resources from one end of the department to the other. College and university budgets have shifted resources away from libraries toward information technology offices over the years, he pointed out, sometimes creating tension between administrators of different branches. Shifting resources is easier when it occurs within the same administrative unit, he said.

In many instances, the change to a unified structure was precipitated by the departure of either a chief librarian or information officer. That was the case at Southwestern. In many instances, universities have saved a chief administrative salary by combining the divisions.

Some institutions have run into snags when trying to create a unified office. Prior to coming to Rhodes, Johnson tried to implement a similar administrative structure at Belmont University. He said the move created anxiety among librarians, who had faculty status there, about what would happen to them if they were placed into a new unit.

The unified model might not be appropriate for every institution, said Joyce Ogburn, university librarian at the University of Utah and president of the Association of College and Research Libraries. At Utah, which is significantly larger than many of the institutions that have adopted merged offices, the library has a significant corps of information technology specialists who help serve students and faculty with most front-line issues, while the central IT office focuses on the university's infrastructure.

But she noted that in the coming years, colleges will see greater integration of library and IT functions, regardless of what structure it takes. "In the long run there has got to be close collaboration, no matter what model we adopt," she said. "It behooves us to be working closely."

— Kevin Kiley

http://www.insidehighered.com/news/2011/09/23/liberal_arts_colleges_merge_it_and_libraries_to_save_money_and_deliver_better_service

Beyond the bomb

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369
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Twenty years after the end of the cold war scientists and the military still need each other.

With a science and technology budget that currently stands at about US$12 billion per year, the US defence complex is the world's largest investor in military research. Much of the money has gone into developing weapons of unprecedented lethality, but a large fraction supports 'dual-use' research, whose products — from the Internet to the Global Positioning System — have enriched society as a whole. And the trove of military data has proved surprisingly useful to scientists studying environmental change (see page 388).

Military efforts are also helping to improve public health. Studies of traumatic brain injuries inflicted by bomb blasts (see page 390) could aid in the diagnosis and treatment of brain injuries in civilians. And the need to keep troops healthy has resulted in advances ranging from a partially effective vaccine against HIV to a mobile-phone-based reporting system for disease cases (see page 395).

Such programmes have been strengthened by JASON, an independent panel of high-level scientists whose advice is often brutally frank (see page 397). But the Pentagon can and should do much more to support dual-use science — by, for example, minimizing the bureaucracy and secrecy that still make it far too difficult for outsiders to gain access to military data.

Defence officials should also insist that their public-health research be meticulously transparent about goals and methods — this is crucial to overcoming mistrust in the developing world. At home, the Pentagon could enhance its credibility among academics by funding discussions on the ethical, legal and social implications of its research — for example, the development of robotic warfare (see page 399).

Most fundamentally, Congress and the Pentagon should continue their strong support for military science. This is not as axiomatic as it was when the United States was in a decades-long, high-stakes technological race with the Soviet Union. Much of today's military research, in the United States and elsewhere, consists of shorter-term problem-solving, such as how to deal with low-tech roadside explosives, or the development of virtual worlds for training troops or aiding their post-injury recovery (see page 406). As the mission becomes more diffuse, high-level support for military science may wane, especially as the Pentagon's overall funding comes under scrutiny (see page 386). Yet cutting and narrowing military research would be short-sighted, especially when the concept of national security is itself expanding, to include not just military strength, but public health, economic vigour, dealing with climate change, and all the other factors that make for a strong society.

http://www.nature.com/nature/journal/v477/n7365/full/477369b.html

A Multi-Part Question

September 23, 2011

NEW ORLEANS -- For many college applicants with multiracial backgrounds, college counselors and admissions officers say, the hardest part of applying to college isn't identifying the right colleges to apply to or crafting essays. It's figuring out which box to check when it comes to race.

With more students coming from multiracial backgrounds and colleges and universities becoming increasingly nuanced in how they ask about and measure diversity, students and institutions alike are trying to figure out how to adequately account for diversity in the application process. The issues faced by multiracial college applicants were a major topic of discussion here Thursday as college counselors convened for the annual meeting of the National Association for College Admission Counseling.

In particular, counselors said, recent changes in the structure of application questions about racial and ethnic background have led to confusion among students -- particularly Latino students -- about how they should identify themselves in the process. The questions are causing stress for students, and institutions are finding the data more convoluted, and sometimes less useful, than before.

Much of the admissions officers' concern centered on how the Common Application, which is used by 460 colleges, asks students about their ethnic and racial identity. Since 2009, in response to changes in federal reporting requirements, ethnicity has been a two-part question on the application, and other institutions' applications have similar language.

The first part asks students to say whether they identify as Latino or Hispanic. The second part of the question asks them -- regardless of how they answered the previous question -- to identify as American Indian or Alaska Native, Asian, black or African American, Native Hawaiian or other Pacific Islander, or white. Students can check as many boxes as they'd like in the second question, and both questions are optional.

Before the change, universities were just required to ask and report whether students identified themselves as African American/Black, Hispanic, Asian/Pacific Islander, American Indian/Alaskan Native, or White, though many institutions also allowed students to choose multiracial. In most instances, students could only select one category. The change in the wording was motivated by a change to what the federal government required colleges to report when it came to data, and the same language was used in the 2010 census.

When the Common Application and other institutions implemented the wording change, many colleges saw an increase in the number of students identifying as multiracial. Admissions officers said Latino or Hispanic students, many of whom didn't traditionally identify as any other ethnicity but felt obligated to answer the second question, drove the increase. Several counselors said the new wording also motivated students who previously would have identified as only one race -- such as a black student whose great-grandfather was white -- to identify as more than one race.

Rob Killion, executive director of the Common Application, said that he regularly hears about issues with the questions in the application but that, because of the federal reporting requirements, there isn't much leeway for changing the questions. "If there was some way that we could make these questions more understandable to kids, we would do it," he said.

Several admissions counselors at Thursday's session said they have seen an increase in the number of students asking them how to answer such questions.

Admissions officials said the new wording creates problems not only for students, but also for colleges and universities. Institutions want to be able to provide the right resources for students from different backgrounds once they're on a campus, counselors said. Different resources might be needed for a multiracial student than for one who identifies as having a single ethnicity.

“What you collect for the feds and what you want to present internally might be different,” said Jarrid Whitney, executive director of admissions and financial aid at the California Institute of Technology. “We can’t always break out the multiracial data in ways that we want to.”

Jim Rawlins, executive director of admissions at Colorado State University, said his institution added a supplemental question about whether students identify as multiracial. That only added more layers of complexity. “We have students who check that box who only checked one of the above boxes, and students who checked more than one of the above boxes who don’t check that box.”

There is also a concern that students might not be authentic in how they answer questions about race and ethnicity, seeking an edge in the application process by identifying as multiracial when they really consider themselves to be only one race.

Asking about racial and ethnic identity in applications is complicated by the fact that many multiracial students have not confronted the question of identity, and most have not made solid determinations about it, by the time they’re applying to college, said Kendall Reid-Webster, a counselor at the Marist School, in Atlanta, who regularly works with students and adults who are struggling with the issue of racial identity.

Bonnie Hall, associate director of admissions at Worcester Polytechnic Institute, said institutions should take time to examine what they are using the data for. If an institution is just using the questions to fill quotas of different races on campus, then they're not really pursuing diversity. If they're using it to try create a variety of perspectives on campus, then the new questions might help them better identify what students can bring. “What is the ultimate goal?” she asked the crowd at the session Thursday. “I would hope that everyone’s answer is real diversity on campus.”

— Kevin Kiley

http://www.insidehighered.com/news/2011/09/23/admissions_counselors_struggle_to_measure_multiracial_students_using_common_application_questions

Aboriginal Australians: The First Explorers

The study derived from a lock of hair donated to a British anthropologist by an Aboriginal man from the Goldfields region of Western Australia in the early 20th century. One hundred years later, researchers have isolated DNA from this same hair, using it to explore the genetics of the first Australians and to provide insights into how humans first dispersed across the globe. (Credit: University of Copenhagen)

ScienceDaily (Sep. 23, 2011) — In an exciting development, an international team of researchers has, for the first time, pieced together the human genome from an Aboriginal Australian.

The results, published in the journal *Science*, re-interpret the prehistory of our species.

By sequencing the genome, the researchers demonstrate that Aboriginal Australians descend directly from an early human expansion into Asia that took place some 70,000 years ago, at least 24,000 years before the population movements that gave rise to present-day Europeans and Asians. The results imply that modern day Aboriginal Australians are in fact the direct descendents of the first people who arrived in Australia as early as 50,000 years ago.

The study derived from a lock of hair donated to a British anthropologist by an Aboriginal man from the Goldfields region of Western Australia in the early 20th century. One hundred years later, researchers have isolated DNA from this same hair, using it to explore the genetics of the first Australians and to provide insights into how humans first dispersed across the globe.

Separation

The genome, shown to have no genetic input from modern European Australians, reveals that the ancestors of the Aboriginal man separated from the ancestors of other human populations some 64-75,000 years ago. Aboriginal Australians therefore descend directly from the earliest modern explorers, people who migrated into Asia before finally reaching Australia about 50,000 years ago. In showing this, the study establishes Aboriginal Australians as the population with the longest association with the land on which they live today. This research is presented with the full endorsement of the Goldfields Land and Sea Council, the organization that represents the Aboriginal traditional owners for the region.

New model for migration

The history of Aboriginal Australians plays a key role in understanding the dispersal of the first humans to leave Africa. Archaeological evidence establishes modern human presence in Australia by about 50,000 years ago, but this study re-writes the story of their journey there.

Previously, the most widely accepted theory was that all modern humans derive from a single out-of-Africa migration wave into Europe, Asia, and Australia. In that model, the first Australians would have branched off from an Asian population, already separated from the ancestors of Europeans. However, this study shows that when ancestral Aboriginal Australians began their private journey, the ancestors of Asians and Europeans had not yet differentiated from each other. Once they did, some 24,000 years after the first Australians had begun their explorations, Asians and remnants of the ancestral Australians intermixed for a period of time.

The first humans were explorers

Professor Eske Willerslev from the University of Copenhagen, who headed the study, explains: "Aboriginal Australians descend from the first human explorers. While the ancestors of Europeans and Asians were sitting somewhere in Africa or the Middle East, yet to explore their world further, the ancestors of Aboriginal Australians spread rapidly; the first modern humans traversing unknown territory in Asia and finally crossing the sea into Australia. It was a truly amazing journey that must have demanded exceptional survival skills and bravery."

The study has wide implications for understanding of how our human ancestors moved across the globe. So far the only ancient human genomes have been obtained from hair preserved under frozen conditions. The researchers have now shown that hair preserved in much less ideal conditions can be used for genome sequencing without risk of modern human contamination that is typical in ancient bones and teeth. Through analysis of museum collections, and in collaboration with descendent groups, researchers can now study the genetic history of many indigenous populations worldwide, even where groups have recently moved about or intermingled.

Story Source:

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

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The Myth of College as a Fairy Tale

September 23, 2011
By Justin D. Martin

I was in college and graduate school for nearly ten years, and in that time I must've had 1,000 different people tell me, "Wait until you graduate and go out in the real world," or "Graduating next year, huh? You'll finally be in the real world." And every time I heard such stupidity I wanted to slam a pie in the speaker's face. Even toward the end of my Ph.D. program, when I was working 70 hours a week and earning $20,000 a year, an occasional nitwit would say something like, "Well the party's almost over; time for the real world."

The collegiate fairy tale myth supposes that I spoiled myself in early adulthood by avoiding "work" and going to college. Presumptuous garbage. Like my students today, I had in college an enormous and time-sensitive workload, social pressures, empty pockets, and little sense of physical continuity. Any psychiatrist will tell you that moving domiciles is one of the most stressful life events that humans experience, and yet we make college students move around like carnies, in and out of dorm rooms, and perhaps urging them to relocate to off-campus housing as upperclassmen. On September 13, the fraternity house of Pi Kappa Alpha at the University of Maine, where I teach, was condemned and 22 students were tossed out. My, how lucky they are to know nothing of real-world pressure!

College years are exciting and liberating, certainly, but they are also a time of myriad deadlines, limited self-efficacy, and a tightrope of time management. I met a college student a few years ago wearing a shirt popular among his classmates that read: "The University of Chicago: Where Fun Goes to Die." While I doubt this elite institution resembles the Gulag, I did believe the young man when he told me that University of Chicago students are worked like dogs.

Not as a college student, but rather now, as a professor, I'm living the dream. I make a fair wage, have strong benefits, and get over three months a year to work almost exclusively on my own research projects. I wear jeans to the office and shave only when I'm bored. I feel no shred of guilt for such freedom; I didn't start earning a livable wage until I was almost 30, and the creative flexibility of the professor's life is what I toiled a decade for. I still work very hard, but I'm paid for it now, and the professional stress I feel is not at the unsustainable decibel that nagged me as an undergraduate.

Nostalgia is a sexy elixir, and it often blurs our recollection of distress as opposed to eustress. Eustress represents life pressures that motivate us and are pro-social, like a manageable work deadline or the tug on our conscience to exercise a few times a week. Distress is harmful pressure that causes us to lose sleep, eat or fast in unhealthy patterns, or exhibit short tempers. When many middle-agers compare their current lives with their college years, they do so while remembering their youthful distress as eustress, and by mislabeling many of their current positive pressures as atypical distress.

The stereotypes that college years are marked by experimentation with substances and sexual precocity do bear some truth, and these pleasures are what many Americans care to remember about their time in the academy, but the idea that college is a low-stress, light-work period is a damn lie.

Young Americans don't go to college to avoid work. They work hard in college so they have a shot at earning a modestly rewarding living. Unfortunately for these young aspirants, they're slogging toward a labor market that older generations of Americans have sullied. Rather than insulting college students by suggesting that they don't know what hard work is, older Americans might instead consider apologizing for the pathetic employment market staring down graduates in this country.

The students I teach are professional jugglers who make a Cirque du Soleil show look like a barn dance. Among them they're balancing academic course loads, community service, part-time or even full-time jobs, loan debt, athletic training and competition, transient housing situations, along with some of life's other gems like a sick parent, a sibling in Afghanistan, or an unplanned pregnancy.

One of the primary reasons educated Americans are such successful professionals is that the college years are hard. "The real world" isn't so daunting to college graduates because they've already spent four or five years in it. The deadlines they face are very real, and I know this because I rigidly impose some of them, and my students know that the word "dead" is in deadline for a reason. I don't go easy on my students, but I also don't belittle the loads they carry. College students in the U.S. are impressive people, and their hard work should be praised, not demeaned.

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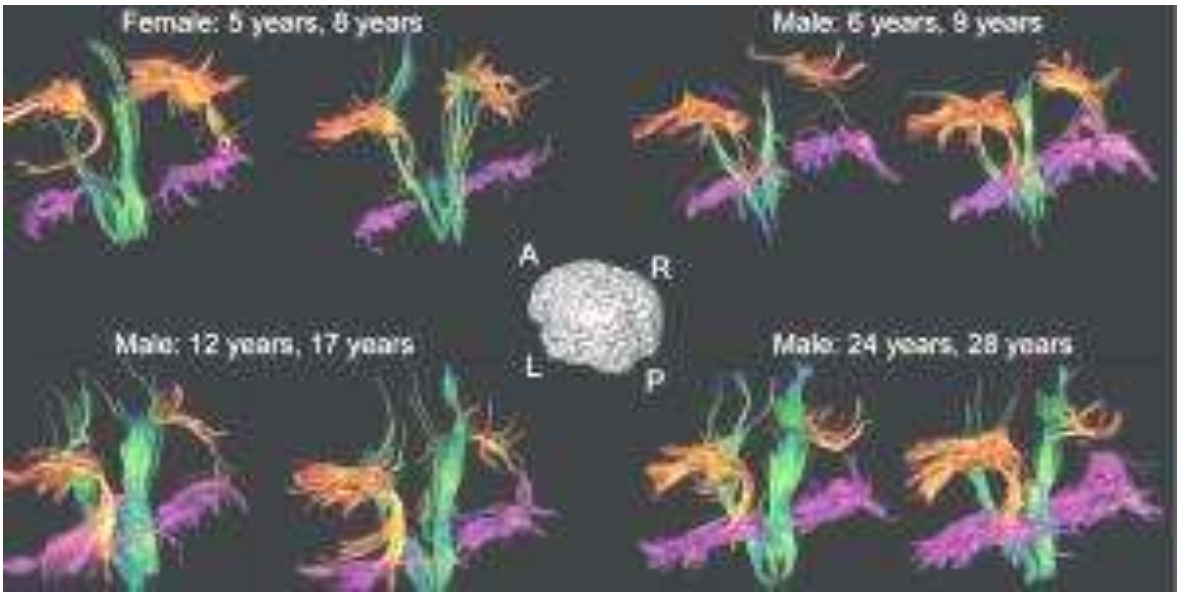
http://www.insidehighered.com/views/2011/09/23/martin_essay_college_students_work_hard_don_t_live_in_a_bubble

Some Brain Wiring Continues to Develop Well Into Our 20s



Sample tracts at two time points. Tracts are shown at two time points for several individuals. (Credit: Image courtesy of University of Alberta)

ScienceDaily (Sep. 23, 2011) — The human brain doesn't stop developing at adolescence, but continues well into our 20s, demonstrates recent research from the Faculty of Medicine & Dentistry at the University of Alberta.

It has been a long-held belief in medical communities that the human brain stopped developing in adolescence. But now there is evidence that this is in fact not the case, thanks to medical research conducted in the Department of Biomedical Engineering by researcher Christian Beaulieu, an Alberta Innovates -- Health Solutions scientist, and by his PhD student at the time, Catherine Lebel. Lebel recently moved to the United States to work at UCLA, where she is a post-doctoral fellow working with an expert in brain-imaging research.

"This is the first long-range study, using a type of imaging that looks at brain wiring, to show that in the white matter there are still structural changes happening during young adulthood," says Lebel. "The white matter is the wiring of the brain; it connects different regions to facilitate cognitive abilities. So the connections are strengthening as we age in young adulthood."

The duo recently published their findings in the *Journal of Neuroscience*. For their research they used magnetic resonance imaging or MRIs to scan the brains of 103 healthy people between the ages of five and 32. Each study subject was scanned at least twice, with a total of 221 scans being conducted overall. The study demonstrated that parts of the brain continue to develop post-adolescence within individual subjects.

The research results revealed that young adult brains were continuing to develop wiring to the frontal lobe; tracts responsible for complex cognitive tasks such as inhibition, high-level functioning and attention. The researchers speculated in their article that this may be due to a plethora of life experiences in young adulthood such as pursing post-secondary education, starting a career, independence and developing new social and family relationships.

An important observation the researchers made when reviewing the brain-imaging scan results was that in some people, several tracts showed reductions in white matter integrity over time, which is associated with the brain degrading. The researchers speculated in their article that this observation needs to be further studied because it may provide a better understanding of the relationship between psychiatric disorders and brain structure. These disorders typically develop in adolescence or young adulthood.

"What's interesting is a lot of psychiatric illness and other disorders emerge during adolescence, so some of the thought might be if certain tracts start to degenerate too soon, it may not be responsible for these disorders, but it may be one of the factors that makes someone more susceptible to developing these disorders," says Beaulieu.

"It's nice to provide insight into what the brain is doing in a healthy control population and then use that as a springboard so others can ask questions about how different clinical disorders like psychiatric disease and neurological disease may be linked to brain structure as the brain progresses with age."

The research conducted by Beaulieu and Lebel was funded by the Canadian Institutes of Health Research and the Canadian Language and Literacy Research Network (CLLRNet).

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Alberta Faculty of Medicine & Dentistry**. The original article was written by Raquel Maurier.

Journal Reference:

1. C. Lebel, C. Beaulieu. **Longitudinal Development of Human Brain Wiring Continues from Childhood into Adulthood**. *Journal of Neuroscience*, 2011; 31 (30): 10937 DOI: 10.1523/JNEUROSCI.5302-10.2011

http://www.sciencedaily.com/releases/2011/09/110922134617.htm

Beyond the Three Percent

September 21, 2011
By Scott McLemee

In 2007, before releasing its first title, Open Letter Books, a literary press based at the University of Rochester, began running a blog called Three Percent. The title comes from an estimate of how large a share of the annual U.S. book output consists of translations. If anything, that figure may have been a little high even at the time. Given the continuing surge in the number of new titles published each year (up 14 percent between 2009 and 2010, thanks in part to print-on-demand), the portion of books in translation is almost certainly shrinking. Whether or not globalization is an irresistible force, provincialism is an immovable object. But Open Letter, for its part, is dedicated to doing what it can. The press brings 10 foreign-language books into English each year (most of them novels) and Three Percent tracks what is happening in the world of literary translation. The blog also sponsors the annual Best Translated Book Award, now in its fifth year.

As it turns out, the latest work from Open Letter was originally written in English. *The Three Percent Problem: Rants and Responses on Publishing, Translation, and the Future of Reading* is an e-book consisting of material that Chad W. Post, who is OL's publisher, has culled from his blogging over the past four years. ("Some were speeches that I had to give and wrote them first for Three Percent," Post said by e-mail. "Two birds and all that.") It can be downloaded from Amazon and Barnes & Noble for $2.99 -- with all of the profit going to pay translators. You could read all this material for free online, of course, but that would be miserly.

So cough up the three bucks, is what I'm trying to say. It goes for a good cause -- and besides, the book is a good deal, even apart from the low price. The pieces have been revised somewhat, and arranged by topic and theme, so that the whole thing now reads like a reasonably cohesive attempt to come to terms with the developments in book culture during the late '00s and early '10s. As John B. Thompson showed in his study *Merchants of Culture* (Polity, 2010), dealing with any particular change in publishing requires you to grapple with the whole system -- the vast apparatus of production and distribution that connects writer and public. Translation is one aspect of it, of course, but it links up in various ways with the rest of publishing. While Post was making his running assessment of the state of literary translation, he also had to think about the new ways we buy and consume texts. One of essays is called "Reading in the Age of Screens," which indeed could be an alternative title for the whole book.

Notification that the book was available came to me last week via Facebook, which is amusing given Post's definite ambivalence about the "all digital, all the time" tendency of contemporary life. "In the digital world," he said in a note, "we tend to stick to what we already know we want, reinforcing certain patterns, and losing some of the serendipity that a lot of readers point to as a huge influence on their life." True, and yet I did buy the book and start reading it (on a screen) within a few minutes, and was able to ask the author questions later that afternoon. The lack of serendipity was not a big problem.

One of the things I wanted to ask Post about was the peculiar role of academe in regard to translation. University presses undoubtedly account for a larger share of each year's crop of translations than trade publishers do. At the same time, the actual work of bridging language barriers has long been undervalued as a form of scholarship. An uninspired monograph generates more institutional credit than a much-needed translation. The Modern Language Association began taking steps in a more encouraging direction a couple of years ago, when Catherine Porter (a prolific translator of books from French) was its president. And this spring, MLA issued guidelines for evaluating translations as part of peer review. But without stronger institutional recognition of the value of translation, the American tendency toward literary isolationism will only get worse -- apart from the occasional surge of interest in, say, Swedish mystery fiction.

According to a database kept by Three Percent, academic presses bring out roughly 15 percent of the translated fiction and poetry appearing each year. “I suspect this figure would be much higher if we tracked nonfiction works as well,” Post told me. “As it stands, nonprofits, university presses, and independents account for 80-85 percent of the published translations.” He mentioned the presses of Columbia University, Texas Tech, and the University of Nebraska as examples of imprints bringing out excellent books in translation. But talking with literary translators working in academe means hearing “a bunch of terrifying stories about their translation work interfering with getting tenure, etc.”

Even so, there are young professors interested in the study of translation -- “and surprisingly,” Post said, “I know at least a few who are being urged (and evaluated) by their departments to continue translating." At the same time, the classroom is a front line in the effort to overcome resistance or indifference to the rest of the world’s literature. “It always shocks me at how few books from France, Germany, Spain, Eastern Europe, etc., that students read during their studies,” he says. “It's as if American and British authors exist in a bubble, or as if students are just supposed to find out about the rich history of world literature in their spare time.... I think it would be ideal if more international works were taught in classes, giving students a chance to explore the issues of translation and helping defuse the trepidation some readers have when approaching a translated book.”

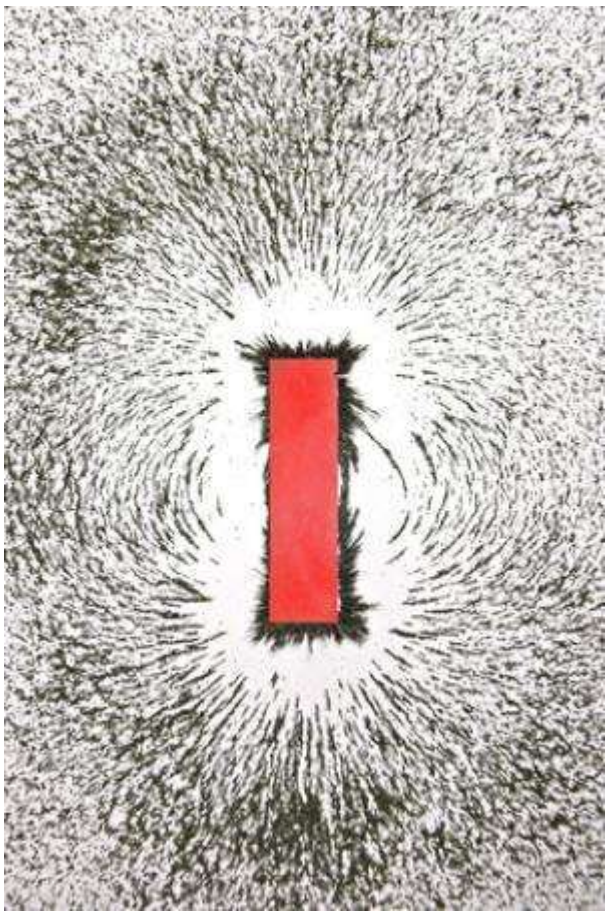
Open Letter works with the program in literary translation studies at the University of Rochester. Students “take a theory class, produce a portfolio of their own translations, and intern with the press.” Post admits that the trends in the publishing world do not point to a future in which translation will be a booming field. Thanks to "depletion in the number of bookstores (especially independents), increased focus on the bottom line, [and] the immense increases in the number of published titles," the portion of translated books "will remain around 3 percent, or even decrease when you start counting self-published titles.” At the same time, a number of small presses with a commitment to publishing translations have emerged over the past decade or so, besides Open Letter. They include Archipelago Books, the Center for the Art of Translation, Europa Editions, Melville House, PEN World Voices, and Words Without Borders. Calling it an issue “as fraught as it could be,” Post notes that Amazon is not only “funding a lot of organizations involved in translation, but they've started AmazonCross, a publishing enterprise focused exclusively on literature in translation.” In 2010, the online bookseller gave $25,000 to the University of Rochester so that the Best Translated Book Awards could begin offering a cash prize to the winning authors and translators.

Someone willing and able to spend the money “could make a huge difference in the landscape for international literature in a short period of time,” Post told me. “This doesn't have to be a corporation at all.… I think that over the next decade, as more small presses come into existence thanks to advances in technology, changes in distribution methods, and general dissatisfaction with a lot of the stuff coming out from corporate presses, the audience for international literature will continue to increase. There may not be that many more titles being published, but the publishers doing this work will get more and more savvy at getting their titles into the hands of interested readers, academics, reviewers, etc. -- people who aren't put off by the idea of reading a translation.”**That** last part is, in the final analysis, the real crux of the matter. Even when books do get translated, they are sometimes promoted very poorly. In *The Three Percent Problem*, Post refers to one university press that seems committed to describing the foreign novels it publishes in terms that are strangely unappealing. Without naming the press I can confirm that the complaint is all too valid: the publisher's catalog always makes the books sound desiccated, lugubrious, and inaction-packed.

It's the kind of thing that reinforces what Post calls "the overriding prejudice" about books in translation: "that they won't sell, that only the most sadomasochistic of people will read them, that reviewers will view these books as being secondary to the original version, etc." The only cure is for enthusiastic readers to communicate among themselves, to strike a spark of interest.

http://www.insidehighered.com/views/mclemee/mclemee_on_three_percent

Cloaking Magnetic Fields: First Antimagnet Developed



Bar magnet with iron filings showing magnetic field pattern. Researchers have designed what they believe to be a new type of magnetic cloak, which shields objects from external magnetic fields, while at the same time preventing any magnetic internal fields from leaking outside. (Credit: © Awe Inspiring Images / Fotolia)

ScienceDaily (Sep. 23, 2011) — Spanish researchers have designed what they believe to be a new type of magnetic cloak, which shields objects from external magnetic fields, while at the same time preventing any magnetic internal fields from leaking outside, making the cloak undetectable.

The development of such a device, described as an 'antimagnet', could offer many beneficial applications, such as protecting a ship's hull from mines designed to detonate when a magnetic field is detected, or allowing patients with pacemakers or cochlear implants to use medical equipment.

In their study, published Sept. 23, in the Institute of Physics and German Physical Society's *New Journal of Physics*, researchers have proved that such a cloak could be built using practical and available materials and technologies, and used to develop an array of applications.

Take, for example, a patient with a pacemaker undergoing an MRI scan. If an MRI's large magnetic field interacts with the pacemaker, it can cause serious damage to both the device and the patient. The metal in the pacemaker could also interact with and distort the MRI's large magnetic field, affecting the machine's detection capabilities.

The researchers, from Universitat Autònoma de Barcelona, are aware that the technology could also be used by criminals to dodge security systems, for example in airports and shops, but they are confident that the new research could benefit society in a positive way, while the risks could be minimized by informing security officials about potential devices, enabling them to anticipate and neutralize problems.

Lead author, Professor Alvar Sanchez, said, "The ideas of this device and their potential applications are far-reaching; however it is conceivable that they could be used for reducing the magnetic signature of forbidden objects, with the consequent threat to security. For these reasons, this research could be taken into account by security officials in order to design safer detection systems and protocols."

The antimagnet has been designed to consist of several layers. The inner layer would consist of a superconducting material that would function to stop a magnetic field from leaking outside of the cloak, which would be very useful to cloak certain metals.

A downside to using this material, however, is that it would distort an external magnetic field placed over the cloak, making it detectable, so the device would need to be combined with several outer layers of metamaterials, which have varying levels of magnetic field permeability, to correct this distortion and leave the magnetic field undisturbed.

The researchers demonstrated the feasibility of the cloak using computer simulations of a ten-layered cylindrical device cloaking a single small magnet.

Impressively, the researchers also showed that the cloak could take on other shapes and function when the cylinder was not fully enclosed, meaning that applications for pacemakers and cochlear implants are even more feasible, given that they require wires to connect to other parts of the body.

"We indeed believe, and hope, that some laboratories could start constructing an antimagnet soon. Of the two components, superconductors are readily available, for example in cylindrical shape, and the key point would be to make the magnetic layers with the desired properties. This may take a bit of work but in principle the ingredients are there," continued Professor Sanchez.

An Institute of Physics spokesperson said, "The research group have put forward a novel and, most importantly, conceivable plan for a magnetic cloak. The obvious next step will be to translate design into fabrication so some of the wide-ranging applications can be realised."

Story Source:

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

Journal Reference:

1. Alvaro Sanchez, Carles Navau, Jordi Prat-Camps, Du-Xing Chen. **Antimagnets: controlling magnetic fields with superconductor–metamaterial hybrids**. *New Journal of Physics*, 2011; 13 (9): 093034 DOI: 10.1088/1367-2630/13/9/093034

http://www.sciencedaily.com/releases/2011/09/110922192056.htm

Measuring Engagement

September 20, 2011
By Peter Ewell , Kay McClenney and Alexander C. McCormick

For more than a decade, the National Survey of Student Engagement (NSSE) and the Community College Survey of Student Engagement (CCSSE) have provided working faculty members and administrators at over 2,000 colleges and universities with actionable information about the extent to which they and their students are doing things that decades of empirical study have shown to be effective. Recently, a few articles by higher education researchers have expressed reservations about these surveys. Some of these criticisms are well-taken and, as leaders of the two surveys, we take them seriously. But the nature and source of these critiques also compel us to remind our colleagues in higher education just exactly what we are about in this enterprise.

Keeping purposes in mind is keenly important. For NSSE and CCSSE, the primary purpose always has been to provide data and tools useful to higher education practitioners in their work. That's substantially different from primarily serving academic research. While we have encouraged the use of survey results by academic researchers, and have engaged in a great deal of it ourselves, this basic purpose fundamentally conditions our approach to "validity." As cogently observed by the late Samuel Messick of the Educational Testing Service, there is no absolute standard of validity in educational measurement. The concept depends critically upon how the results of measurement are used. In applied settings, where NSSE and CCSSE began, the essential test is what Messick called "consequential validity" -- essentially the extent to which the results of measurement are useful, as part of a larger constellation of evidence, in diagnosing conditions and informing action. This is quite different from the pure research perspective, in which "validity" refers to a given measure's value for building a scientifically rigorous and broadly generalizable body of knowledge.

The NSSE and CCSSE benchmarks provide a good illustration of this distinction. Their original intent was to provide a heuristic for campuses to initiate broadly participatory discussions of the survey data and implications by faculty and staff members. For example, if data from a given campus reveal a disappointing level of academic challenge, educators on that campus might examine students' responses to the questions that make up that benchmark (for example, questions indicating a perception of high expectations). As such, the benchmarks' construction was informed by the data, to be sure, but equally informed by decades of past research and experience, as well as expert judgment. They do not constitute "scales" in the scientific measurement tradition but rather groups of conceptually and empirically related survey items. No one asked for validity and reliability statistics when Art Chickering and Zelda Gamson published the well-known *Seven Principles for Good Practice in Undergraduate Education* some 25 years ago, but that has not prevented their productive application in hundreds of campus settings ever since.

The purported unreliability of student self-reports provides another good illustration of the notion of consequential validity. When a student is asked to tell us the frequency with which she engaged in a particular activity (say, making a class presentation), it is fair to question how well her response reflects the *absolute* number of times she actually did so. But that is not how NSSE and CCSSE results are typically used. The emphasis is most often placed instead on the *relative* differences in response patterns across groups -- men and women, chemistry and business majors, students at one institution and those elsewhere, and so on. Unless there is a systematic bias that differentially affects how the groups respond, there is little danger of reaching a faulty conclusion. That said, NSSE and CCSSE have invested considerable effort to investigate this issue through focus groups and cognitive interviews with respondents on an ongoing basis. The results leave us satisfied that students know what we are asking them and can respond appropriately.

Finally, NSSE and CCSSE results have been empirically linked to many important outcomes including retention and degree completion, grade-point-average, and performance on standardized generic skills examinations by a range of third-party multi-institutional validation studies involving thousands of students. After the application of appropriate controls (including incoming ability measures) these relationships are

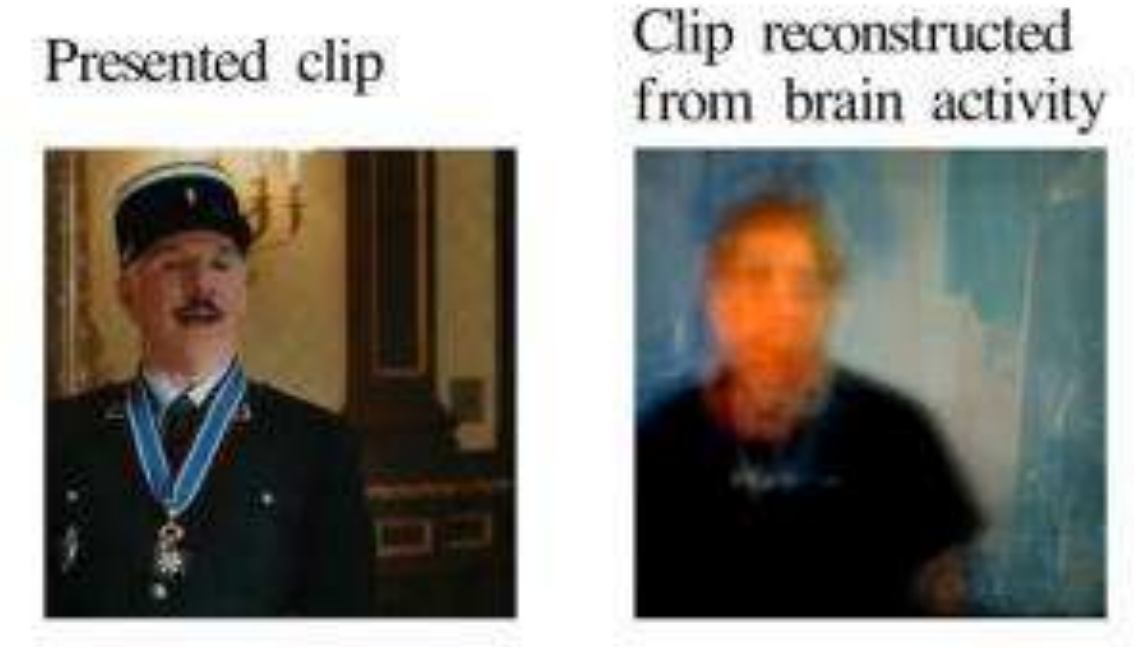
statistically significant, but modest. But, as the work of Ernest Pascarella and Patrick Terenzini attests, such is true of virtually every empirical study of the determinants of these outcomes over the last 40 years. In contrast, the recent handful of published critiques of NSSE and CCSSE are surprisingly light on evidence. And what evidence is presented is drawn from single-institution studies based on relatively small numbers of respondents.

We do not claim that NSSE and CCSSE are perfect. No survey is. As such, we welcome reasoned criticism and routinely do quite a bit of it on our own. The bigger issue is that work on student engagement is part of a much larger academic reform agenda, whose research arm extends beyond student surveys to interview studies and on-campus fieldwork. A prime example is the widely acclaimed volume *Student Success in College* by George Kuh and associates, published in 2005. To reiterate, we have always enjoined survey users to employ survey results with caution, to triangulate them with other available evidence, and to use them as the beginning point for campus discussion. We wish we had an electron microscope. Maybe our critics can build one. Until then, we will continue to move forward on a solid record of adoption and achievement.

Peter Ewell is senior vice president of the National Center for Higher Education Management Systems and chairs the National Advisory Boards for both NSSE and CCSSE. Kay McClenney is a faculty member at the University of Texas at Austin, where she directs the Center for Community College Student Engagement. Alexander C. McCormick is a faculty member at Indiana University at Bloomington, where he directs the National Survey of Student Engagement.

http://www.insidehighered.com/views/2011/09/20/essay_defending_the_value_of_surveys_of_student_engagement

Scientists Use Brain Imaging to Reveal the Movies in Our Mind



Researchers have succeeded in decoding and reconstructing people's dynamic visual experiences -- in this case, watching Hollywood movie trailers. (Credit: Image courtesy of University of California - Berkeley)

ScienceDaily (Sep. 22, 2011) — Imagine tapping into the mind of a coma patient, or watching one's own dream on YouTube. With a cutting-edge blend of brain imaging and computer simulation, scientists at the University of California, Berkeley, are bringing these futuristic scenarios within reach.

Using functional Magnetic Resonance Imaging (fMRI) and computational models, UC Berkeley researchers have succeeded in decoding and reconstructing people's dynamic visual experiences -- in this case, watching Hollywood movie trailers.

As yet, the technology can only reconstruct movie clips people have already viewed. However, the breakthrough paves the way for reproducing the movies inside our heads that no one else sees, such as dreams and memories, according to researchers.

"This is a major leap toward reconstructing internal imagery," said Professor Jack Gallant, a UC Berkeley neuroscientist and coauthor of the study to be published online Sept. 22 in the journal *Current Biology*. "We are opening a window into the movies in our minds."

Eventually, practical applications of the technology could include a better understanding of what goes on in the minds of people who cannot communicate verbally, such as stroke victims, coma patients and people with neurodegenerative diseases.

It may also lay the groundwork for brain-machine interface so that people with cerebral palsy or paralysis, for example, can guide computers with their minds.

However, researchers point out that the technology is decades from allowing users to read others' thoughts and intentions, as portrayed in such sci-fi classics as "Brainstorm," in which scientists recorded a person's sensations so that others could experience them.

Previously, Gallant and fellow researchers recorded brain activity in the visual cortex while a subject viewed black-and-white photographs. They then built a computational model that enabled them to predict with overwhelming accuracy which picture the subject was looking at.

In their latest experiment, researchers say they have solved a much more difficult problem by actually decoding brain signals generated by moving pictures.

"Our natural visual experience is like watching a movie," said Shinji Nishimoto, lead author of the study and a post-doctoral researcher in Gallant's lab. "In order for this technology to have wide applicability, we must understand how the brain processes these dynamic visual experiences."

Nishimoto and two other research team members served as subjects for the experiment, because the procedure requires volunteers to remain still inside the MRI scanner for hours at a time.

They watched two separate sets of Hollywood movie trailers, while fMRI was used to measure blood flow through the visual cortex, the part of the brain that processes visual information. On the computer, the brain was divided into small, three-dimensional cubes known as volumetric pixels, or "voxels."

"We built a model for each voxel that describes how shape and motion information in the movie is mapped into brain activity," Nishimoto said.

The brain activity recorded while subjects viewed the first set of clips was fed into a computer program that learned, second by second, to associate visual patterns in the movie with the corresponding brain activity.

Brain activity evoked by the second set of clips was used to test the movie reconstruction algorithm. This was done by feeding 18 million seconds of random YouTube videos into the computer program so that it could predict the brain activity that each film clip would most likely evoke in each subject.

Finally, the 100 clips that the computer program decided were most similar to the clip that the subject had probably seen were merged to produce a blurry yet continuous reconstruction of the original movie.

Reconstructing movies using brain scans has been challenging because the blood flow signals measured using fMRI change much more slowly than the neural signals that encode dynamic information in movies, researchers said. For this reason, most previous attempts to decode brain activity have focused on static images.

"We addressed this problem by developing a two-stage model that separately describes the underlying neural population and blood flow signals," Nishimoto said.

Ultimately, Nishimoto said, scientists need to understand how the brain processes dynamic visual events that we experience in everyday life.

"We need to know how the brain works in naturalistic conditions," he said. "For that, we need to first understand how the brain works while we are watching movies."

Other coauthors of the study are Thomas Naselaris with UC Berkeley's Helen Wills Neuroscience Institute; An T. Vu with UC Berkeley's Joint Graduate Group in Bioengineering; and Yuval Benjamini and Professor Bin Yu with the UC Berkeley Department of Statistics.

Story Source:

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

Journal Reference:

1. Shinji Nishimoto, An T. Vu, Thomas Naselaris, Yuval Benjamini, Bin Yu, Jack L. Gallant. **Reconstructing Visual Experiences from Brain Activity Evoked by Natural Movies**. *Current Biology*, 22 September 2011 DOI: 10.1016/j.cub.2011.08.031

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The Challenge of Technology

September 19, 2011
By Barry Mills

As we begin this new academic year, I see a set of complex and confusing issues that are potentially and likely transformational in the context of Bowdoin College. Beyond Bowdoin, these forces are likely to be fundamentally disruptive, certainly in the K-12 educational arena and even more likely in higher education, which seeks to educate large numbers of students to be employed in a growing, successful, and just society supported by vibrant U.S. and world economies -- something we all hope to achieve once again. These issues all involve the role of technology in education.

Shortly before I became president of Bowdoin in 2001, our trustees and many others were caught up in the tech boom of the late 1990s. I remember well a trustee retreat in the late 90s that was centered in large part on this very issue. Many trustees shared the then-conventional wisdom that technology would fundamentally change the educational landscape in profound ways. Back then, there were grand predictions about how technology would become a dominant force in the educational landscape. Then came the dot-com bust, as we began the 21st century, and those very same folks significantly discounted the projected impact of technology.

Yet, the impact has been undeniable: e-mail, text messaging, Facebook, Linked-in, Twitter, wireless, iPhones, iPads, Android, Skype, BlackBerry, Blackboard, mobile apps, the Cloud, and on and on. Today, you can use an app to find out what's for lunch at our campus, and one of our professors, Eric Chown, is even teaching a course on building these apps.

I own an iPhone, an iPad, an Apple computer, and an iPod. My son George calls me "Apple Redundant." I think it's fair to say that we actually find ourselves on the brink of that revolution or evolution envisioned in the late '90s, but it happened organically and through innovation, surrounded by less hype and without the market exuberance. At least until recently.

In a *Wall Street Journal* op-ed last month, Marc Andreessen -- the venture capitalist who co-founded Netscape and has backed Facebook, Groupon, Skype, Twitter, Zynga and Foursquare -- wrote that we are on the verge of a new time, when "software is eating the world." Why? Because as he writes, "six decades into the computer revolution, four decades since the invention of the microprocessor, and two decades into the rise of modern Internet, all the technology required to transform industries through software finally works and can be delivered on a global basis."

As Andreessen tells us, over two billion people now have broadband Internet access, up from 80 million a decade ago. In the next 10 years he expects that 5 billion people worldwide will own a smartphone -- "instant access to the full power of the Internet."

Today, the world's largest bookseller is Amazon. The largest video service: Netflix. The dominant music companies: iTunes, Pandora, and Spotify. And it goes on and on. Just ask the class of 2015 about video games! We are in a moment of change, disruptive change that is altering the landscape, and Andreessen's view is that health care (thankfully) and education are next in line for fundamental software-based transformation.

I connected Andreessen's views with a book I read this summer recommended to me by another brilliant investor. The book -- *The Information* by James Gleick -- is a history of the way we have thought about and chronicled information over human history. Many years ago -- but not so long ago in human history -- information was transmitted only through the spoken word. The world was fundamentally changed by the invention of the printing press, which allowed us to reproduce facts and information and to make them accessible to many. Today, we live in a society of the web and mobile applications that is equally or perhaps

even more transformational. I understand I am conflating years of transformation to make a point, but I think of it this way.

Remember the movie, "Monty Python and the Holy Grail," when the bridge keeper asks Sir Robin to name the capital of Assyria? Well, back then, if you didn't know the answer, the only option was to ask the other guys standing at the bridge before being catapulted into the abyss. Later, one might look it up in an encyclopedia, in an almanac (remember almanacs?), or in a card catalog in the library. Today, Sir Robin would pull out his iPhone and have the answer in a heartbeat, avoiding an untimely demise.

And in a more modern context, I always ask students from far off states how they found their way to Bowdoin. In years past, it was frequently about camp in Maine, a Bowdoin graduate who was their teacher, NESCAC, the *Fiske Guide*, or the Princeton Review or when Tony Soprano visited Bowdoin. This year, for the first time, the answer -- from more than a few students I met in matriculation -- was Google. And remarkably and importantly, more than a quarter of our applicants are now students we have never seen on campus or who have no contact with us before they apply.

My point is that we are storing, sorting, and filtering information today in ways that are vastly different than we did even 50 or 25 or maybe even 10 years ago.

Now, I am very willing to concede that it is just not the same to do art history research without traveling to a dark archive in France and looking directly at a priceless piece of art. And I am also willing to concede that generations have found it invaluable to walk through the stacks in the library and to locate books and treatises that they didn't even know existed. I understand the power of these experiences and this scholarship, but one must also concede that the transmission and organization of facts and information has changed, and has changed forever.

In the future, we are less likely to be limited by one surprising find in a library, there because a librarian decided to purchase a particular book. Instead, we will be surprised because an algorithm has placed a particular source at the top of our search list on Google, or the next Google. Of course, the future will decide if the process of discovery is as equally rewarding.

And, let me point out that in a world where there is persistent attention on the cost of higher education, the cost of books for our most expensive first-year seminar this year is over $150, and all of those books may be bought online for less than half the cost. Saves money, saves the environment and lightens back strain from the backpack. At this point, online textbooks are a work in progress -- but there are educators and entrepreneurs working today to deliver in the near term a new generation of online textbooks that focus on information, "accessibility, searchability and collaboration." These textbooks will not merely provide information, but provide it in a variety of learning and teaching modes that will make learning more accessible for their readers. One of our faculty colleagues reminds me often that our mission here is not to teach, but to learn. Recognizing that different people, including students, learn in different ways is essential. And, these new advances will allow us to become more effective if we are open and willing.

Where I am headed with all this is that I am convinced that we cannot responsibly ignore the changing dynamics in the way that information is stored and delivered, because these changing dynamics will undoubtedly change our role as educators. The imperative to supply information is being supplanted -- or more likely refocused -- by the availability of the information if sorted and organized responsibly.

The last dot I want to connect is the work of Clayton Christensen, a Harvard Business School professor who has done work throughout his career studying "disruptive change." Christensen studies industries that are convinced that they are serving their clients and customers well, innovating to serve their most important needs. These industries are, in fact, doing so. Until one transformative moment, their clients are willing to pay the high costs of the service or product they deliver. Then, one day, the business is replaced by a lower cost,

more effective model, often driven by the power of technology. And the mature, well-conceived, high-quality, high-cost supplier is suddenly an anachronism.

Christensen's examples include PCs displacing mainframes, department stores yielding to Walmart, and Fidelity overtaking conventional investment banks, among others. Not surprisingly, Christensen has focused on technology as the disruptive change agent for education at the K-12 level. Also, given the economics of higher education and the skills required of our workforce, Christensen sees the advent of distance learning as a powerful change agent for higher education.

Christensen's focus in higher education is more directed at institutions that are educating vast numbers of students less than effectively at high cost. His thesis, borne out by current trends, is that the substance of the education these institutions provide will likely be delivered in the future much more through distance learning and possibly through for-profit education that is more cost effective and directed to skills and education that translates into job readiness.

For elite institutions such as Bowdoin, Christensen is more circumspect about disruptive change because the high-quality education provided by these elite colleges and universities -- education that is recognized as opening the doors to select and high paying jobs or academic careers -- will, over the near term, be sustainable despite the high cost because of the return on the investment and the quality of the education. But it will by its very structure be available to a privileged few who have the ability to pay the cost or are supported by institutional endowment.

So, what does all of this mean for Bowdoin and other elite liberal arts colleges? I'll be the first to admit, I don't know. But I am convinced it is worth thinking about. Let me be clear that I believe there will always be a place for the mode and substance of a liberal arts education and the residential life experience that Bowdoin represents. And in a Google and Wikipedia world with a high degree of access to facts and information, there will be a premium on a liberal arts education that helps students learn which facts are worth knowing, what they can rely on, and how to interpret these facts. I believe society will come to value our form of education even more because what we do, at our best, is more than imparting information. We enable our students to develop judgment and perspective using the available facts and information in a manner based on critical judgment and analysis.

College education at Bowdoin is less about merely accumulating facts that are a keystroke away, and more about evaluating the veracity of the information and developing the powers of interpretation and judgment. But given the reliance on talent that our model demands, it will be, by its very nature, the high-cost model of education. That's why we must be excellent, sophisticated, and the very best at imparting the wisdom and judgment our students will need to be important citizens of our country and the world.

Rather than being disruptive to Bowdoin, I am convinced that technology and modes of learning emancipated by technology will have the power, potentially, to incrementally, rather than disruptively, improve our educational model. Take the new student information system as an example. For years, Bowdoin students have registered for courses using paper cards submitted to our registrar. In fact, just this week, 485 first-year students registered in the last two days on paper cards for their courses this semester, and all are ready to go. And members of our faculty have advised students effectively for years, based on course catalogs and paper versions of course availability supplemented by our clunky current system. Our students have done well throughout this time, well advised and finding themselves in the courses they desire.

Now we will spend a few million dollars on a computer software that will allow people to register online and the system will collate and organize more effectively information about our students and our curriculum. The important question is, how will this make us a better college? How will we advise our students better with this technology? I suspect the answer will lie in how we change the way we approach the challenge. Or stated more directly, the technology will not improve our quality unless we utilize the technology to improve our

educational and business practices. One cannot justify the expenditure unless we improve the quality of what we do for our students, except, of course, if one is satisfied that this system is better merely because it might take less time and maybe makes us more productive -- neither a goal that inherently suggests good advising. The interesting test case will be to see if technology improves our performance as students and as faculty advisers, a task that I have asked the folks implementing the system to assess over the coming years.

One could imagine innumerable ways that technology and the power to connect with colleagues nationally and internationally could allow us to expand our course offerings, or to become more global. Already, the power to connect is used in meaningful ways by our faculty to collaborate with colleagues in research and scholarship. I suggest that expanding our conception of teaching to incorporate this technology in similar ways will incrementally enhance our educational enterprise. For faculty who seek global connections for our students, there are mechanisms available to bring the global community into our classrooms here in Brunswick, Maine. Is this a perfect solution or an absolute replacement for foreign study? No. But it is quite likely that our students, faculty, and community would benefit from real time, face-to-face interaction with students and faculty in foreign lands.

We are continually and thoughtfully asked by our faculty and students to create new programs at Bowdoin. There is often genuine enthusiasm and good reason to consider the new program, but creating something new at Bowdoin from a standing start, where we might have one or two faculty committed to the concept, is difficult and expensive. Would it be better to build it ourselves in our residential community? Most definitely, yes. But it is also certain that resources over the next period will be limited and the power to connect with colleagues at other places that could create the critical mass for these new programs is worth considering. It is also apparent, at least to me, that there are opportunities to improve the substance and scope of our model of education by providing sophisticated programs and advanced study at the outer edges of certain disciplines where a few students would be interested in study.

How we utilize this technology while preserving the core of our college, the very brand of our college -- the connection between our faculty as teachers and scholars and our students as learners -- will be critical. But we should not turn away from opportunities to expand the sophistication and scope of our program in ways that adds to the depth and strength of our college. Not only because the opportunities might be cost-effective, but because the overall quality of a Bowdoin education will be directly linked with the excellence and sophistication of that program. For, while we are certain that the relationship between our faculty and students is at the core of what we do, that core will not be sustainable if the relationship is not grounded in the most sophisticated educational resource available. If we are not first-rate and intellectually sophisticated, over time we will not attract first-rate, sophisticated faculty or students. Connection and collaboration are crucial, but a sophisticated Bowdoin is fundamental.

Of course, I am sufficiently humble to understand that the musings of a college president do not effect change. Nothing happens at a college or university unless the faculty or some group of faculty decides on their own that there is something to an idea, and takes the initiative. But I think the future is clear, and we will be looking in our rearview mirror if we are not prepared to grapple with these new opportunities.

Finally, and more ambitiously, elite institutions would be well-served to consider more directly the means to impart more broadly and more cost-effectively the sum and substance of what we teach and how we learn to large segments of our society. Technology has the power to be the conductor of this education and to empower masses of people, rather than just a privileged few at these elite institutions. By this, I mean more comprehensive efforts than merely open-source education and free access to lectures.

Elite institutions with the brightest minds and the most ambitious programs would be well served to consider how we flatten the curve to make this quality education available readily to a much broader section of our society. This is a big project, but it is an imperative that elite higher education should take on. For while there is no doubt that elite institutions are doing great work making our form of education available to many who in

the past could never gain access, the size of our institutions collectively and the access we create is a small fraction of the demographic that could benefit from the educational opportunity. A vexing task, but one made more possible every day through the innovation of software and technology. It is, in my view, a challenge that elite educational institutions should take on, especially given the demographics of the country and the cost and price implications of our institutions.

As you shift in your seats, let me reemphasize for you that I am confident in the style and substance of what we do at Bowdoin. But I am equally confident that we live in a rapidly changing educational landscape where it is essential that we exist at the highest level of sophistication in order to attract and retain the best faculty and students and support the cost structure of our form of education. To my mind, the transformation of education that we face demands that we have the confidence to explore these new opportunities.

Barry Mills is president of Bowdoin College. This essay is adapted from his convocation talk to new students this fall.

Particles Appear to Travel Faster Than Light: OPERA Experiment Reports Anomaly in Flight Time of Neutrinos

The OPERA experiment observes a neutrino beam from CERN 730 km away at Italy's INFN Gran Sasso Laboratory. (Credit: Copyright INFN)

ScienceDaily (Sep. 23, 2011) — Scientists with the OPERA experiment, which observes a neutrino beam from CERN 730 km away at Italy's INFN Gran Sasso Laboratory, are presenting surprising new results (in a seminar at CERN on Sept. 23, 2011) that appear to show neutrinos traveling faster than light.

The OPERA result is based on the observation of over 15000 neutrino events measured at Gran Sasso, and appears to indicate that the neutrinos travel at a velocity 20 parts per million above the speed of light, nature's cosmic speed limit. Given the potential far-reaching consequences of such a result, independent measurements are needed before the effect can either be refuted or firmly established. This is why the OPERA collaboration has decided to open the result to broader scrutiny. The collaboration's result is available on the preprint server arXiv (http://arxiv.org/list/hep-ex/new).

"This result comes as a complete surprise," said OPERA spokesperson, Antonio Ereditato of the University of Bern. "After many months of studies and cross checks we have not found any instrumental effect that could explain the result of the measurement. While OPERA researchers will continue their studies, we are also looking forward to independent measurements to fully assess the nature of this observation."

"When an experiment finds an apparently unbelievable result and can find no artefact of the measurement to account for it, it's normal procedure to invite broader scrutiny, and this is exactly what the OPERA collaboration is doing, it's good scientific practice," said CERN Research Director Sergio Bertolucci. "If this measurement is confirmed, it might change our view of physics, but we need to be sure that there are no other, more mundane, explanations. That will require independent measurements."

In order to perform this study, the OPERA Collaboration teamed up with experts in metrology from CERN and other institutions to perform a series of high precision measurements of the distance between the source and the detector, and of the neutrinos' time of flight. The distance between the origin of the neutrino beam and OPERA was measured with an uncertainty of 20 cm over the 730 km travel path. The neutrinos' time of flight was determined with an accuracy of less than 10 nanoseconds by using sophisticated instruments including advanced GPS systems and atomic clocks. The time response of all elements of the CNGS beam line and of the OPERA detector has also been measured with great precision.

"We have established synchronization between CERN and Gran Sasso that gives us nanosecond accuracy, and we've measured the distance between the two sites to 20 centimetres," said Dario Autiero, the CNRS researcher who will give this afternoon's seminar. "Although our measurements have low systematic uncertainty and high statistical accuracy, and we place great confidence in our results, we're looking forward to comparing them with those from other experiments."

"The potential impact on science is too large to draw immediate conclusions or attempt physics interpretations. My first reaction is that the neutrino is still surprising us with its mysteries." said Ereditato. "Today's seminar is intended to invite scrutiny from the broader particle physics community."

The OPERA experiment was inaugurated in 2006, with the main goal of studying the rare transformation (oscillation) of muon neutrinos into tau neutrinos. One first such event was observed in 2010, proving the unique ability of the experiment in the detection of the elusive signal of tau neutrinos.

The seminar will be webcast at http://webcast.cern.ch.

Story Source:

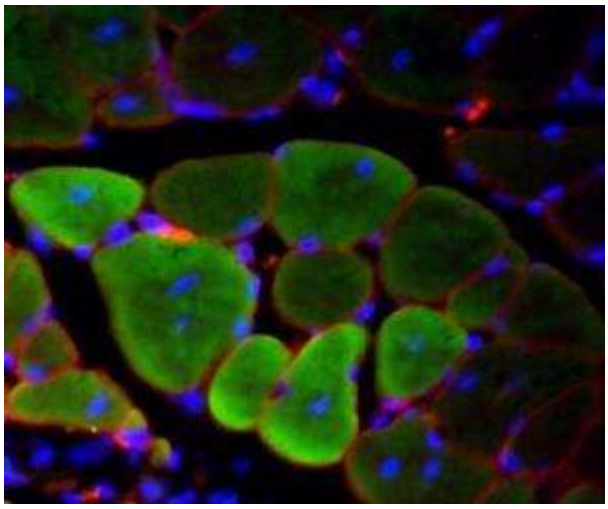
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Istituto Nazionale di Fisica Nucleare**.

Journal Reference:

1. OPERA. **Measurement of the neutrino velocity with the OPERA detector in the CNGS beam**. *arXiv.org*, 2011; [link]

http://www.sciencedaily.com/releases/2011/09/110923084425.htm

Bioengineers Reprogram Muscles to Combat Degeneration



The newly reprogrammed muscle cells, shown here emitting green fluorescence, were injected into mice and successfully fused to make new muscle fibers and repair damaged tissue. (Credit: Image by Preeti Paliwal, UC Berkeley)

ScienceDaily (Sep. 23, 2011) — Researchers at the University of California, Berkeley, have turned back the clock on mature muscle tissue, coaxing it back to an earlier stem cell stage to form new muscle. Moreover, they showed in mice that the newly reprogrammed muscle stem cells could be used to help repair damaged tissue.

The achievement, described in the Sept. 23 issue of the journal *Chemistry & Biology*, "opens the door to the development of new treatments to combat the degeneration of muscle associated with muscular dystrophy or aging," said study principal investigator Irina Conboy, UC Berkeley assistant professor of bioengineering.

Skeletal muscle tissue is composed of elongated bundles of myofibers, which are individual muscle cells (myoblasts) that have fused together. This fusion of individual cells is considered the final step of skeletal muscle differentiation.

"Muscle formation has been seen as a one-way trip, going from stem cells to myoblasts to muscle fiber, but we were able to get a multi-nucleated muscle fiber to reverse course and separate into individual myoblasts," said Conboy, who is also a member of the Berkeley Stem Cell Center and an investigator with the California Institute for Quantitative Biosciences (QB3). "For many years now, people have wanted to do this, and we accomplished that by exposing the tissue to small molecule inhibitor chemicals rather than altering the cell's genome."

Not all stem cells are created equal

Current research on treatments based upon pluripotent cells -- the type of stem cell that can turn into any type of adult cell -- have been challenging. Pluripotent cells can either come from embryonic tissue, a source of controversy, or from adult, differentiated cells that have been coaxed to de-differentiate into an embryonic-like state. This latter technique produces induced pluripotent stem cells (iPS) through the delivery of specific genes that reprogram the adult cells to revert back to a pluripotent stem cell state.

Pluripotent stem cells can divide almost indefinitely, and if not driven toward a particular organ type, the cells quickly form teratomas, or tumors containing a combination of immature malformed tissues -- a serious downside of the use of iPS cell tansplantation as a potential treatment.

"The biggest challenge with both embryonic stem cells or iPS cells is that even a single undifferentiated pluripotent cell can multiply in vivo and give rise to tumors," said study lead author Preeti Paliwal, a UC Berkeley post-doctoral researcher in bioengineering. "Importantly, reprogrammed muscle stem-progenitor cells do not form tumors when transplanted into muscle in vivo."

Unlike pluripotent stem cells, which can differentiate into any type of adult cell, adult organ-specific stem cells have a set destiny. Muscle progenitor cells are fated to become muscle tissue, liver progenitor cells can only become liver tissue, and so on.

"In addition, it is difficult to differentiate these embryonic-like cells into functional adult tissue, such as blood, brain or muscles," said Paliwal. "So rather than going back to a pluripotent stage, we focused on the progenitor cell stage, in which cells are already committed to forming skeletal muscle and can both divide and grow in culture. Progenitor cells also differentiate into muscle fibers in vitro and in vivo when injected into injured leg muscle."

Using molecular signals to rewind the clock

Muscle progenitor cells are normally situated alongside mature myofibers, which is why they are also called satellite cells. These cells lay dormant until called into action to repair and build new muscle tissue that has been injured or worn out. This happens regularly as we go about our daily lives, and muscle builders know this cycle when they tear old muscle fibers and build new tissue by lifting weights.

However, that process of repair gets worn out in people with Duchenne muscular dystrophy, a genetic condition in which muscles degenerate because of a defective structural protein and the subsequent exhaustion of muscle stem cells.

To get a multi-nucleated muscle fiber to reverse course and separate into individual myoblasts, the researchers exposed the differentiated muscle tissue to tyrosine phosphatase inhibitors, giving the signal to mature cells to start dividing again.

"Exposing the myofibers to this tyrosine phosphatase inhibitor transmits signals for cell division, but that can be too dramatic a change for them," said Paliwal. "These cells had already fused together into one big structure, sharing one cytoplasm and one cytoskeleton. If you simply tell them to divide, many of them start dying. You confuse them."

To solve this, the researchers also used an inhibitor of apoptosis, or cell death. "We basically brainwashed the cells to go into the cell cycle, to divide and also not die in the process," said Paliwal.

Conboy noted that the use of molecular inhibitors to de-differentiate mature tissue is a sought-after application in the stem cell field.

"These tiny chemicals go inside the cell and change the way the cell behaves without changing its genome," she said. "The inhibitors were only used for 48 hours, enough time for the fused myofibers to split into individual cells, and then they were washed away. The cells can proceed to live and die as normal, so there is no risk of them dividing uncontrollably to become tumors."

Newly reprogrammed cells get glowing review

To prove unequivocally that the myoblasts they produced were de-differentiated from mature muscle tissue rather than activated from the few satellite cells that accompany myofibers, the researchers genetically labeled the fused myofibers with a protein that emits green fluorescent light. The researchers then knew that the myoblasts that glowed green could have only come from the differentiated myofiber.

To test the viability of the newly regenerated myobasts, the researchers first cultured them in the lab to show that they could grow, multiply and fuse normally into new myofibers. The researchers then injected the de-differentiated myoblasts into live mice with damaged muscles.

"After two to three weeks, we checked the muscle and saw new muscle fibers that glowed green, proving that the progenitor cells we derived from mature muscle tissue contributed to muscle repair in vivo in mice," said Paliwal.

The researchers say the next steps include testing the process on human muscle tissue and screening for other molecular compounds that could help de-differentiate mature tissue.

"This approach won't work for all degenerative diseases," said Conboy. "It might work for some diseases or conditions where we can start with differentiated tissue, such as neurons or liver cells. But patients with type I diabetes, for instance, lack the pancreatic beta-islet cells to produce insulin, so there is no functional differentiated tissue to start with. Our approach is not a replacement for pluripotent cells, but it's an additional tool in the arsenal of stem cell therapies."

The National Institutes of Health and the California Institute of Regenerative Medicine helped support this work.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of California - Berkeley**. The original article was written by Sarah Yang.

Journal Reference:

1. Preeti Paliwal, Irina M. Conboy. **Inhibitors of Tyrosine Phosphatases and Apoptosis Reprogram Lineage-Marked Differentiated Muscle to Myogenic Progenitor Cells**. *Chemistry & Biology*, Volume 18, Issue 9, 1153-1166, 23 September 2011 DOI: 10.1016/j.chembiol.2011.07.012

http://www.sciencedaily.com/releases/2011/09/110922121403.htm

Evolutionary Tree of Life for Mammals Greatly Improved

Mark Springer is a professor of biology at UC Riverside. (Credit: UCR Strategic Communications.)

ScienceDaily (Sep. 23, 2011) — An international research team led by biologists at the University of California, Riverside and Texas A&M University has released for the first time a large and robust DNA matrix that has representation for all mammalian families. The matrix -- the culmination of about five years of painstaking research -- has representatives for 99 percent of mammalian families, and covers not only the earliest history of mammalian diversification but also all the deepest divergences among living mammals.

"This is the first time this kind of dataset has been put together for mammals," said Mark Springer, a professor of biology at UC Riverside, who co-led the research project with William Murphy, an associate professor of genetics at Texas A&M. "Until now, no one has been able to assemble this kind of matrix, based on DNA sequences from many different genes, to examine how the different families of mammals are related to each other. This dataset, with all the sequences we generated, provides a large and reliable foundation -- a springboard -- for biologists to take the next leap in this field of work. We can now progress from phylogeny that has representatives for all the different mammalian families to phylogenies that have representatives for genera and species."

Phylogeny is the history of organismal lineages as they change through time. A vast evolutionary tree, called the Tree of Life, represents the phylogeny of organisms, the genealogical relationships of all living things.

As most introductory biology textbooks will show, organisms are biologically classified according to a hierarchical system characterized by seven main taxonomic ranks: kingdom, phylum or division, class, order, family, genus, species. For example, humans are known taxonomically as *Homo sapiens*. Their genus is *Homo*, the family is Hominidae, the order is Primates and the class is Mammalia.

To date divergence times on their phylogeny of mammalian families, Springer and colleagues used a "relaxed molecular clock." This kind of molecular clock allows for the use of multiple rates of evolution instead of using one rate of evolution that governs all branches of the Tree of Life. They also used age estimates for numerous fossil mammals to calibrate their time tree.

"We need to have calibrations to input into the analysis so that we know, for example, that elephants and their nearest relatives have been separate from each other since at least the end of the Paleocene -- more than 55 million years ago," Springer said. "We were able to put together a diverse assemblage of fossil calibrations from different parts of the mammalian tree, and we used it in conjunction with molecular information to assemble the most robust time tree based on sequenced data that has been developed to date."

Study results appear Sept. 22 in *Science Express*.

"This study is the beginning of a larger plan to use large molecular data sets and sophisticated techniques for dating and estimating rates of diversification to resolve much larger portions of the mammalian tree, ultimately including all described species, as well as those that have gone recently extinct or for which only museum material may be available," Murphy said. "Only then can we really begin to understand the role of the environment and events in earth history in promoting the generation of living biodiversity. This phylogeny also serves as a framework to understand the history of the unique changes in the genome that underlie the vast morphological diversity observed in the more than 5400 living species of mammals."

Springer explained that the research team looked for spikes in the diversification history of mammals and used an algorithm to determine whether the rate of diversification was constant over time or whether there were distinct pulses of rate increases or decreases. The researchers found an increase in the diversification rate 80-82 million years ago, which corresponds to the time -- specifically, the end of the Cretaceous Terrestrial Revolution -- when a lot of different orders were splitting from each other.

"This is when flowering plants diversified, which provided opportunities for the diversification of small mammals," Springer said.

Springer and colleagues also detected a second spike in the diversification history of mammals at the end of the Cretaceous -- 65.5 million years ago, when dinosaurs, other large terrestrial vertebrates, and many marine organisms went extinct, opening up a vast ecological space.

"Such ecological voids can get filled quickly," Springer explained. "We see that in mammals, even though different orders such as primates and rodents split from each other back in the Cretaceous, the orders did not diversify into their modern representations until after the Cretaceous, 65.5 million years ago. The void seems to have facilitated the radiation -- that is, branching in conjunction with change -- of different orders of several mammals into the adaptive zones they occupy today. After the Cretaceous, we see increased diversification, with some lineages becoming larger and more specialized."

The researchers stress that their time tree is a work in progress. In the next two years, they expect to construct a supermatrix, also based on gene sequences, and include the majority of living mammalian species. The current work incorporates 164 mammalian species.

"Our phylogeny, underpinned by a large number of genes, sets the stage for us to understand how the different mammalian species are related to each other," Springer said. "That will help us understand when these species diverged from each other. It will allow us to look for taxonomic rates of increase or decrease over time in different groups in various parts of the world so that we can understand these diversification rate changes in relationship to important events in Earth's history -- such as the diversification of flowering plants and changes associated with climatic events. Researchers routinely make use of phylogenies in diverse fields such as ecology, physiology, and biogeography, and the new phylogeny for mammalian families provides a more accurate framework for these studies.

"When you understand how taxa are related to each other," Springer added, "you can start to understand which changes at the genome level underpin key morphological changes associated with, say, flight and

echolocation in bats or loss of teeth in toothless mammals. In other words, you can pinpoint key molecular changes that are associated with key morphological changes. This would be extremely difficult, if not altogether impossible, without the kind of robust molecular phylogeny we have developed."

The research team also reports that their results contradict the "delayed rise of present-day mammals" hypothesis. According to this hypothesis, introduced by a team of scientists in a 2007 research paper, the ancestors of living mammals underwent a pulse of diversification around 50 million years ago, possibly in response to the extinction of archaic mammals that went extinct at the end of the Paleocene (around 56 million years ago). The earlier extinction event around 65.5 million years ago, which resulted in the demise of the dinosaurs, had no effect on the diversification of the ancestors of extant mammals, according to the 2007 research paper.

"Our analysis shows that the mass extinction event 65.5 million years ago played an important role in the early diversification and adaptive radiation of mammals," Springer said. "The molecular phylogeny we used to develop the matrix is far more reliable and accurate, and sets our work apart from previous studies."

Story Source:

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

Journal Reference:

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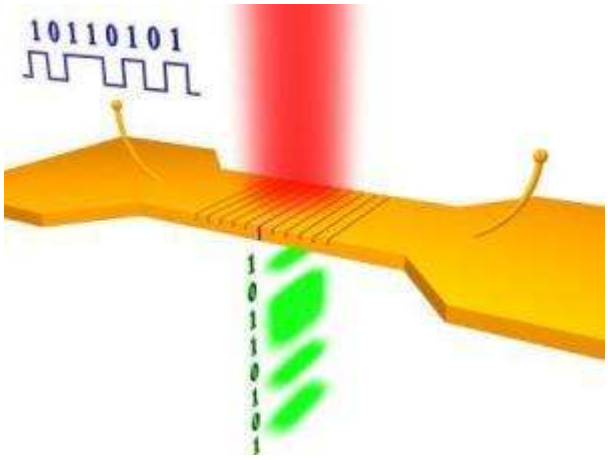
http://www.sciencedaily.com/releases/2011/09/110922141907.htm

Nanoscale Nonlinear Light Source Optical Device Can Be Controlled Electronically



This schematic demonstrates how the EFISH device's dual electric and optical functions could be used to communicate data in a chip-based environment. (Credit: Mark Brongersma)

ScienceDaily (Sep. 22, 2011) — Not long after the development of the first laser in 1960 scientists discovered that shining a beam through certain crystals produced light of a different color; more specifically, it produced light of exactly twice the frequency of the original. The phenomenon was dubbed second harmonic generation.

The green laser pointers in use today to illustrate presentations are based on this science, but producing such a beautiful emerald beam is no easy feat. The green light begins as an infrared ray that must be first processed through a crystal, various lenses and other optical elements before it can illuminate that PowerPoint on the screen before you.

It was later discovered that applying an electrical field to some crystals produced a similar, though weaker, beam of light. This second discovery, known as EFISH -- for electric-field-induced second harmonic light generation -- has amounted mostly to an interesting bit of scientific knowledge and little more. EFISH devices are big, demanding high-powered lasers, large crystals and thousands of volts of electricity to produce the effect. As a result, they are impractical for all but a few applications.

In a paper published September 22 in *Science*, engineers from Stanford have demonstrated a new device that shrinks EFISH devices by orders of magnitude to the nanoscale. The result is an ultra-compact light source with both optical and electrical functions. Research implications for the device range from a better understanding of fundamental science to improved data communications.

Spring-loaded electrons

The device is based on the physical forces that bind electrons in orbit around a nucleus.

"It's like a spring," said Mark Brongersma, an associate professor of materials science and engineering at Stanford.

In most cases, when you shine a light on an atom, the added energy will pull the electron away from the positively charged nucleus very predictably, in a linear fashion, so that when the light is turned off and the electron springs back to its original orbit, the energy released is the same as the light that displaced it.

The key phrase here being: "in most cases." When the light source is a high-intensity laser shining on a solid, researchers discovered that the farther the electrons are pulled away from the nuclei the less linearly the light interacts with the atoms.

"In other words, the light-matter interaction becomes nonlinear," said Alok Vasudev, a graduate student and co-author of the paper. "The light you get out is different from the light you put in. Shine a strong near-infrared laser on the crystal and green light exactly twice the frequency emerges."

Engineering possibilities

"Now, Alok and I have taken this knowledge and reduced it to the nanoscale," said the paper's first author, Wenshan Cai, a post-doctoral researcher in Brongersma's lab. "For the first time we have a nonlinear optical device at the nanoscale that has both optical and electrical functionality. And this offers some interesting engineering possibilities."

For many photonic applications, including signal and information processing, it is desirable to electrically manipulate nonlinear light generation. The new device resembles a nanoscale bowtie with two halves of symmetrical gold leaf approaching, but not quite touching, in the center. This thin slit between the two halves is filled with a nonlinear material. The narrowness is critical. It is just 100 nanometers across.

"EFISH requires a huge electrical field. From basic physics we know that the strength of an electric field scales linearly with the applied voltage and inversely with the distance between the electrodes -- smaller distance, stronger field and vice versa," said Brongersma. "So, if you have two electrodes placed extremely close together, as we do in our experiment, it doesn't take many volts to produce a giant electrical field. In fact, it takes just a single volt."

"It is this fundamental science that allows us to shrink the device by orders of magnitude from the human scale to the nanoscale," said Cai.

Enter plasmonics

Brongersma's area of expertise, plasmonics, then enters the scene. Plasmonics is the study of a curious physical phenomenon that occurs when light and metal interact. As photons strike metal they produce waves of energy coursing outward over the surface of the metal, like the ripples when a pebble is dropped in a pond.

Engineers have learned to control the direction of the ripples by patterning the surface of the metal in such a way that almost all of the energy waves are funneled inward toward the slit between the two metallic electrodes.

The light pours into the crevice as if over the edge of a waterfall and there it intensifies, producing light some 80 times stronger than the already intense laser levels from which it came. The researchers next apply a modest voltage to the metal resulting in the tremendous electrical field necessary to produce an EFISH beam.

Practical applications

"This type of device may one day find application in the communications industry," says Brongersma. "Most of the masses of information and social media interaction we send through our data centers, and the future data we will someday create, are saved and transmitted as electrical energy -- ones and zeros."

"Those ones and zeroes are just a switch; one is on, zero is off," said Cai. "As more energy-efficient optical information transport is rapidly gaining in importance, it is not a great leap to see why devices that can convert electrical to optical signals and back are of great value."

For the time being, however, the researchers caution that practical applications remain down the road, but they have created something new.

"It's a great piece of basic science," said Brongersma. "It is work that combines several disciplines -- nonlinear optics, electronics, plasmonics, and nanoscale engineering -- into a really interesting device that could keep us busy for awhile."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Stanford School of Engineering**. The original article was written by Andrew Myers.

Journal Reference:

1. W. Cai, A. P. Vasudev, M. L. Brongersma. **Electrically Controlled Nonlinear Generation of Light with Plasmonics**. *Science*, 2011; 333 (6050): 1720 DOI: 10.1126/science.1207858

http://www.sciencedaily.com/releases/2011/09/110922141914.htm

Aquarium Fishes Are More Aggressive in Reduced Environments, New Study Finds

Freshwater aquarium. (Credit: © Matthew Jones / Fotolia)

ScienceDaily (Sep. 22, 2011) — An angry glare from the family goldfish might not be the result of a missed meal, but a too-humble abode. Fish in a cramped, barren space turn mean, a study from Case Western Reserve University has found. Ornamental fishes across the U.S. might be at risk, all 182.9 million of them.

"The welfare of aquarium fishes may not seem important, but with that many of them in captivity, they become a big deal," said Ronald Oldfield, an instructor of biology at Case Western Reserve. Why, then, has the welfare of pet fishes been overlooked among the scientific community?

Oldfield is the first to scientifically study how the environment of home aquariums affects the aggressive behavior of ornamental fishes. The results are published in the online *Journal of Applied Animal Welfare Science*, volume 14, issue 4.

Oldfield compared the behavior of Midas cichlids (*Amphilophus citrinellus*) in a variety of environments: within their native range in a crater lake in Nicaragua, in a large artificial stream in a zoo, and in small tanks of the sizes typically used to by pet owners.

The study focused on juvenile fish to remove aggressive behavior related to mating. Also, resources such as food and shelter were removed prior to observation to eliminate direct competition.

Along with environment size, Oldfield tested the complexity of an environment and the effects of number of fish within tanks.

The addition of obstacles and hiding places using rocks, plants, or other similar objects can increase the complexity of the aquarium environment.

He found that an increase in tank size and complexity can reduce harmful aggressive behaviors, and make for healthier fish at home.

Oldfield quantified aggressive behavior as a series of displays and attacks separated by at least a second. Displays are body signals such as flaring fins. An attack could be a nip, chase, or charge at another fish.

In aquariums, these behaviors can lead to injury and in extreme cases to death.

Aggressive behavior was not correlated with small-scale changes in either group size or habitat size alone. However, a significant difference was observed in environments sufficiently large and complex: fish spent less time exhibiting aggressive behavior.

"This more natural environment elicits more natural behaviors, which are more interesting to observers," Oldfield said.

And, for the fish themselves, their lives can be vastly improved with these simple changes to their environments.

"If we are going to try to create a society as just as possible, we need to do everything we can to minimize negative effects," Oldfield said.

But why should anyone beyond fish enthusiasts care about fish behavior?

Minimizing negative effects extends beyond the treatment of ornamental fishes. Interactions between humans and other species could apply.

Humans have intimate relationships with a variety of fishes. They provide food and sport for many people. Some are used for decoration, and others are well-loved pets or may become addicting hobbies.

Additionally, conditions for animals in the rapidly growing field of aquaculture and on factory farms are issues of contention.

Oldfield is not trying to support any extreme agendas. "I'm not trying to ban human use of animals- I just think that if we are going to interact with them then we should be as informed as possible."

Relatively simple fish behavior can also serve as a basic model for more complex behaviors.

In the future, Oldfield said, "This study might help us to better understand how human behavior changes when people are placed in different social environments." Violence in prisons might be linked in part to the smaller space and reduced stimuli.

Until then, the 182.9 million ornamental fishes in the United States may benefit from this study. The family goldfish can swim in peace, enjoying the remodeled space.

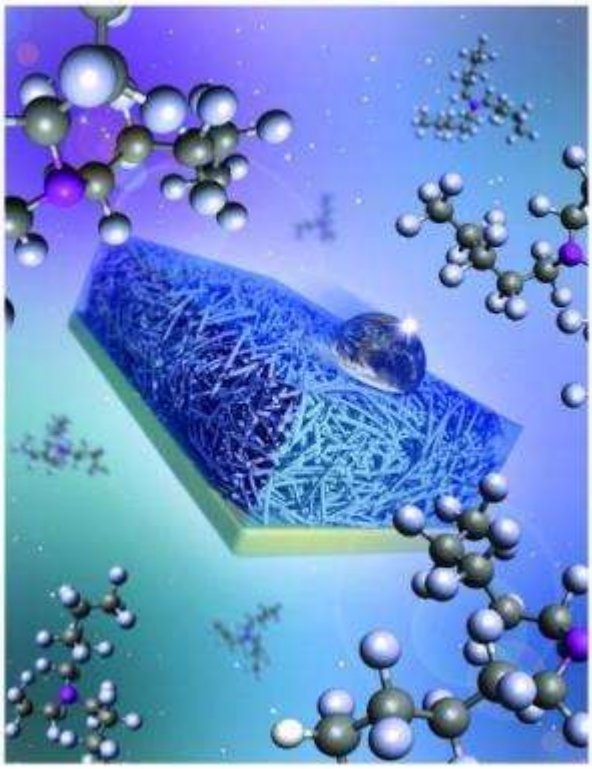
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Case Western Reserve University**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Ronald G. Oldfield. **Aggression and Welfare in a Common Aquarium Fish, the Midas Cichlid**. *Journal of Applied Animal Welfare Science*, 2011; 14 (4): 340 DOI: 10.1080/10888705.2011.600664

http://www.sciencedaily.com/releases/2011/09/110922102241.htm

Carnivorous Plant Inspires Coating That Resists Just About Any Liquids



This is an illustration showing a schematic of slippery surface and its characteristics of repelling many fluids present on the earth (as symbolized by the earth reflected on the liquid drop). (Credit: Courtesy of James C. Weaver and Peter Allen.)

ScienceDaily (Sep. 22, 2011) — After a rain, the cupped leaf of a pitcher plant becomes a virtually frictionless surface. Sweet-smelling and elegant, the carnivore attracts ants, spiders, and even little frogs. One by one, they slide to their doom.

Adopting the plant's slick strategy, a group of applied scientists at Harvard have created a material that repels just about any type of liquid, including blood and oil, and does so even under harsh conditions like high pressure and freezing temperatures.

The bio-inspired liquid repellence technology, described in the September 22 issue of *Nature*, should find applications in biomedical fluid handling, fuel transport, and anti-fouling and anti-icing technologies. It could even lead to self-cleaning windows and improved optical devices.

"Inspired by the pitcher plant, we developed a new coating that outperforms its natural and synthetic counterparts and provides a simple and versatile solution for liquid and solid repellency," says lead author Joanna Aizenberg, Amy Smith Berylson Professor of Materials Science at the Harvard School of Engineering and Applied Sciences (SEAS), Director of the Kavli Institute for Bionano Science and Technology at Harvard, and a Core Faculty member at the Wyss Institute for Biologically Inspired Engineering at Harvard.

By contrast, current state-of-the-art liquid repellent surfaces have taken cues from a different member of the plant world. The leaves of the lotus resist water due to the tiny microtextures on the surface; droplets balance on the cushion of air on the tips of the surface and bead up.

The so-called lotus effect, however, does not work well for organic or complex liquids. Moreover, if the surface is damaged (e.g., scratched) or subject to extreme conditions, liquid drops tend to stick to or sink into the textures rather than roll away. Finally, it has proven costly and difficult to manufacture surfaces based on the lotus strategy.

The pitcher plant takes a fundamentally different approach. Instead of using burr-like, air-filled nanostructures to repel water, the plant locks in a water layer, creating a slick coating on the top. In short, the fluid itself becomes the repellent surface.

"The effect is similar to when a car hydroplanes, the tires literally gliding on the water rather than the road," says lead author Tak-Sing Wong, a postdoctoral fellow in the Aizenberg lab. "In the case of the unlucky ants, the oil on the bottom of their feet will not stick to the slippery coating on the plant. It's like oil floating on the surface of a puddle."

Inspired by the pitcher plant's elegant solution, the scientists designed a strategy for creating slippery surfaces by infusing a nano/microstructured porous material with a lubricating fluid. They are calling the resulting bio-inspired surfaces "SLIPS" (Slippery Liquid-Infused Porous Surfaces).

"Like the pitcher plant, SLIPS are slippery for insects, but they are now designed to do much more: they repel a wide variety of liquids and solids," says Aizenberg. SLIPS show virtually no retention, as very little tilt is needed to coax the liquid or solid into sliding down and off the surface.

"The repellent fluid surface offers additional benefits, as it is intrinsically smooth and free of defects," says Wong. "Even after we damage a sample by scraping it with a knife or blade, the surface repairs itself almost instantaneously and the repellent qualities remain, making SLIPS self-healing." Unlike the lotus, the SLIPS can be made optically transparent, and therefore ideal for optical applications and self-cleaning, clear surfaces.

In addition, the near frictionless effect persists under extreme conditions: high pressures (as much as 675 atmospheres, equivalent to seven kilometers under the sea) and humidity, and in colder temperatures. The team conducted studies outside after a snowstorm; SLIPS withstood the freezing temperatures and even repelled ice.

"Not only is our bio-inspired surface able to work in a variety of conditions, but it is also simple and cheap to manufacture," says co-author Sung Hoon Kang, a Ph.D. candidate in the Aizenberg lab. "It is easily scalable because you can choose just about any porous material and a variety of liquids."

To see if the surface was truly up to nature's high standards, they even did a few experiments with ants. In tests, the insects slid off the artificial surface or retreated to safer ground after only a few timorous steps.

The researchers anticipate that the pitcher plant-inspired technology, for which they are seeking a patent, could one day be used for fuel- and water-transport pipes, and medical tubing (such as catheters and blood transfusion systems), which are sensitive to drag and pressure and are compromised by unwanted liquid-surface interactions. Other potential applications include self-cleaning windows and surfaces that resist bacteria and other types of fouling (such as the buildup that forms on ship hulls). The advance may also find applications in ice-resistant materials and may lead to anti-sticking surfaces that repel fingerprints or graffiti.

"The versatility of SLIPS, their robustness and unique ability to self-heal makes it possible to design these surfaces for use almost anywhere, even under extreme temperature and pressure conditions," says Aizenberg. "It potentially opens up applications in harsh environments, such as polar or deep sea exploration, where no satisfactory solutions exist at present. Everything SLIPS!"

Aizenberg is also Professor of Chemistry and Chemical Biology in the Department of Chemistry and Chemical Biology, and Susan S. and Kenneth L. Wallach Professor at the Radcliffe Institute for Advanced Study. Her co-authors included Tak-Sing Wong, Sung Hoon Kang, Sindy K.Y. Tang, Benjamin D. Hatton, and Alison Grinthal, all at SEAS, and Elizabeth J. Smythe, at the Schlumberger-Doll Research Center.

Story Source:

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

Journal Reference:

1. Tak-Sing Wong, Sung Hoon Kang, Sindy K. Y. Tang, Elizabeth J. Smythe, Benjamin D. Hatton, Alison Grinthal, Joanna Aizenberg. **Bioinspired self-repairing slippery surfaces with pressure-stable omniphobicity**. *Nature*, 2011; 477 (7365): 443 DOI: 10.1038/nature10447

http://www.sciencedaily.com/releases/2011/09/110921134526.htm

Monkeys Also Reason Through Analogy, Study Shows

Baboons. New research shows that monkeys are capable of making analogies. (Credit: © stefanie van der vin / Fotolia)

ScienceDaily (Sep. 24, 2011) — Recognizing relations between relations is what analogy is all about. What lies behind this ability? Is it uniquely human? A study carried out by Joël Fagot of the Laboratoire de Psychologie Cognitive (CNRS/Université de Provence) and Roger Thompson of the Franklin & Marshall College (United States) has shown that monkeys are capable of making analogies.

Their results are just published in the journal *Psychological Science*.

A cat takes care of a kitten and a bird feeds fledglings: although the context is different, these two situations are similar and we can conclude that both cases involve a mother and its offspring. For a long time researchers believed that this type of analogical reasoning was impossible without language and that it was restricted to humans or, at best, great apes that had been taught a language. However, two scientists, Joël Fagot of the Laboratoire de Psychologie Cognitive (CNRS/Université de Provence) and Roger Thompson of the Franklin & Marshall College in the United States, have demonstrated that monkeys are capable of making analogies without language.

The two researchers carried out their experiment on 29 baboons (*Papio papio*) of variable ages, which could freely perform the proposed exercise (this represents a large number of animals for this type of experiment). First of all, the baboons were shown two geometric shapes on a touch screen, for example two squares. After they touched one of these shapes, two other pairs of shapes appeared on the screen, such as: a triangle and a star for the first pair and two identical ovals for the second pair. To successfully complete the exercise and be rewarded, the animal had to touch the pair representing the same relation (of identity or difference) as the initial pair (here, the two ovals).

In other words, the baboon had to detect relations between relations, which is the definition of analogy. After an intensive learning period covering several thousand tests, 6 baboons correctly performed the task, thus demonstrating an ability to resolve analogy problems. Furthermore, the researchers suspended the task for nearly one year before proposing it again to the baboons. The animals re-learnt the task much faster than during the initial training, which shows that they remembered the situation.

This work therefore shows that language is not necessary to analogy. But how can animals use this skill? This adaptive ability, especially useful to the monkey, could in particular serve in the transfer of knowledge from one field to another.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **CNRS (Délégation Paris Michel-Ange)**.

Journal Reference:

1. Roger K. R. Thompson and Joël Fagot. **Generalized Relational Matching by Guinea Baboons (Papio papio) in two by two-item analogy problems**. *Psychological Science*, 20 September 2011

http://www.sciencedaily.com/releases/2011/09/110923102213.htm

Nature Offers Key Lessons On Harvesting Solar Power, Say Chemists

Half the green pigment (chlorophyll) in this Costa Rican rain forest is bound in the light-harvesting complex LHCII (shown in the inset). By studying these natural solar energy antennas, researchers have learnt new physical principles underlying the design of "circuits" that harvest and transport energy from the sun. (Credit: Greg Scholes)

ScienceDaily (Sep. 24, 2011) — Clean solutions to human energy demands are essential to our future. While sunlight is the most abundant source of energy at our disposal, we have yet to learn how to capture, transfer and store solar energy efficiently. According to University of Toronto chemistry professor Greg Scholes, the answers can be found in the complex systems at work in nature.

"Solar fuel production often starts with the energy from light being absorbed by an assembly of molecules," said Scholes, the D.J. LeRoy Distinguished Professor at U of T. "The energy is stored fleetingly as vibrating electrons and then transferred to a suitable reactor. It is the same in biological systems. In photosynthesis, for example, antenna complexes composed of chlorophyll capture sunlight and direct the energy to special proteins called reaction centres that help make oxygen and sugars. It is like plugging those proteins into a solar power socket."

In an article in *Nature Chemistry* to be published Sept. 23, Scholes and colleagues from several other universities examine the latest research in various natural antenna complexes. Using lessons learned from these natural phenomena, they provide a framework for how to design light harvesting systems that will route the flow of energy in sophisticated ways and over long distances, providing a microscopic "energy grid" to regulate solar energy conversion.

A key challenge is that the energy from sunlight is captured by coloured molecules called dyes or pigments, but is stored for only a billionth of a second. This leaves little time to route the energy from pigments to molecular machinery that produces fuel or electricity. How can we harvest sunlight and utilize its energy before it is lost?

"This is why natural photosynthesis is so inspiring," said Scholes. "More than 10 million billion photons of light strike a leaf each second. Of these, almost every red-coloured photon is captured by chlorophyll pigments which feed plant growth." Learning the workings of these natural light-harvesting systems fostered a vision, proposed by Scholes and his co-authors, to design and demonstrate molecular "circuitry" that is 10 times smaller than the thinnest electrical wire in computer processors. These energy circuits could control, regulate, direct and amplify raw solar energy which has been captured by human-made pigments, thus preventing the loss of precious energy before it is utilized.

Last year, Scholes led a team that showed that marine algae, a normally functioning biological system, uses quantum mechanics in order to optimize photosynthesis, a process essential to its survival. These and other insights from the natural world promise to revolutionize our ability to harness the power of the sun.

"Lessons from nature about solar light harvesting" was written by Scholes, Graham Fleming of the University of California, Berkeley, Alexandra Olaya-Castro of University College, London UK and Rienk van Grondelle of VU University in Amsterdam, The Netherlands.

Story Source:

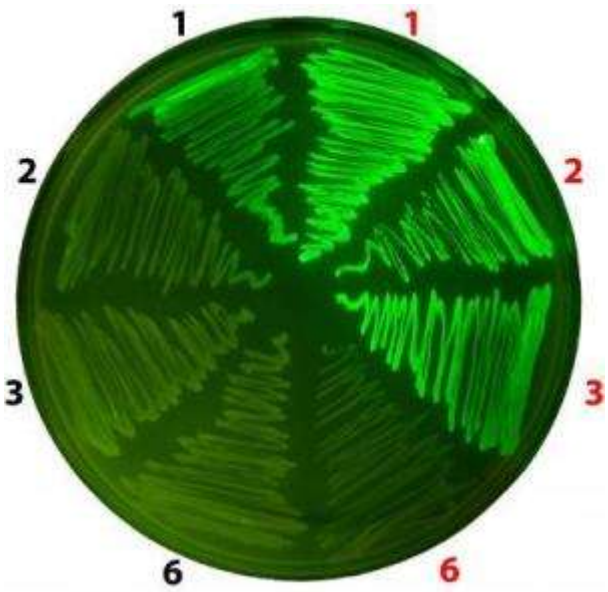
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Toronto**.

Journal Reference:

1. Gregory D. Scholes, Graham R. Fleming, Alexandra Olaya-Castro, Rienk van Grondelle. **Lessons from nature about solar light harvesting**. *Nature Chemistry*, 2011; 3 (10): 763 DOI: 10.1038/nchem.1145

http://www.sciencedaily.com/releases/2011/09/110923095801.htm

Bionic Bacteria May Help Make New Drugs, Biofuels: Artificially Enhanced Bacteria Capable of Producing New Kinds of Synthetic Chemicals



These bacterial smears show common E. coli strains that allow unnatural amino acid (Uaas) incorporation at one site only (left side), and an engineered strain that enables the incorporation of Uaas at multiple sites simultaneously (right side). The glow indicates the bacteria are producing full-length proteins with Uaas incorporated at different numbers of sites (as indicated by the surrounding numbers), a necessary step for their potential use in the production of new drugs and biofuels. (Credit: Image courtesy of Salk Institute for Biological Studies)

ScienceDaily (Sep. 22, 2011) — A strain of genetically enhanced bacteria developed by researchers at the Salk Institute for Biological Studies may pave the way for new synthetic drugs and new ways of manufacturing medicines and biofuels, according to a paper published September 18 in *Nature Chemical Biology*.

For the first time, the scientists were able to create bacteria capable of effectively incorporating "unnatural" amino acids -- artificial additions to the 20 naturally occurring amino acids used as biological building blocks -- into proteins at multiple sites. This ability may provide a powerful new tool for the study of biological processes and for engineering bacteria that produce new types of synthetic chemicals.

"This provides us with a lot more room to think about what we can do with protein synthesis," said Lei Wang, assistant professor in Salk's Chemical Biology and Proteomics Laboratory and holder of the Frederick B. Rentschler Developmental Chair. "It opens up new possibilities, from creating drugs that last longer in the blood stream to manufacturing chemicals in a more environmentally friendly manner."

In 2001, Wang and his colleagues were the first to create bacteria that incorporated unnatural amino acids (Uaas) into proteins, and, in 2007, they first used the technique in mammalian cells. They did this by creating an "expanded genetic code," overriding the genetic code of the cells and instructing them to use the artificial amino acids in the construction of proteins.

The addition of Uaas changes the chemical properties of proteins, promising new ways to use proteins in research, drug development and chemical manufacturing.

For instance, Wang and his colleagues have inserted Uaas that will glow under a microscope when exposed to certain colors of light. Because proteins serve as the basis for a wide range of cellular functions, the ability to visualize this machinery operating in live cells and in real time helps scientists decipher a wide range of biological mechanisms, including those involved in the development of disease and aging.

Genetically modified bacteria are already used for producing medicines, such as synthetic insulin, which has largely replaced the use of animal pancreases in the manufacture of drugs used by diabetics to regulate their blood sugar levels.

To date, such recombinant DNA technology has used only natural amino acids, which limits the possible functions of the resulting protein products. The ability to insert Uaas could dramatically expand the possible uses of such technology, but one major barrier has limited the use of Uaas: only a single Uaa at a time could be incorporated into a protein.

To insert the instructions for including a Uaa in a bacterium's genetic code, Wang and his colleagues exploited stop codons, special sequences of code in a protein's genetic blueprint. During protein production, stop codons tell the cellular machinery to stop adding amino acids to the sequence that forms backbone of the protein's structure.

In 2001, Wang and his colleagues modified the genetic sequence of the bacteria *Escherichia coli* to selectively include a stop codon and introduced engineered molecules inside the bacteria, which surgically insert a Uaa at the stop codon. This trained the bacteria to produce proteins with the Uaa incorporated in their backbone.

The problem was that another biological actor, a protein known as release factor 1 (RF1), would stop the production of a Uaa-containing protein too early. Although scientists could insert stop codons for Uaas at multiple places along genetic sequence, the release factor would cut the protein off at the first stop codon, preventing production of long proteins containing multiple Uaas.

"To really make use of this technology, you want to be able to engineer proteins that contain unnatural amino acids at multiple sites, and to produce them in high efficiency," Wang said. "It was really promising, but, until now, really impractical."

In their new paper, the Salk researchers and their collaborators at the University of California, San Diego described how they got around this limitation. Since RF1 hindered production of long Uaa-containing proteins, the scientists removed the gene that produces RF1. Then, because *E. Coli* dies when the RF1 gene is deleted, they altered production of an alternative actor, release factor 2 (RF2), so that it could rescue the engineered bacterium.

The result was a strain of bacteria capable of efficiently producing proteins containing Uaas at multiple places. These synthetic molecules hold promise for the development of drugs with biological functions far beyond what is possible with proteins that include only naturally occurring amino acids. They may also serve as the basis for manufacturing everything from industrial solvents to biofuels, possibly helping to address the economic and environmental concerns associated with petroleum-based manufacturing and transportation.

"This is the first time we've been able to produce a viable strain of bacteria capable of this," Wang said. "We still have a ways to go, but this makes the possibility of using unnatural amino acids in biological engineering far closer to being reality."

The research was funded by the Beckman Young Investigator Program, the California Institute for Regenerative Medicine, the March of Dimes Foundation, the Mary K. Chapman Foundation, the National

Institutes of Health, the National Science Foundation, the Pioneer Fellowship, the Ray Thomas Edwards Foundation and the Searle Scholar Program.

Story Source:

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

Journal Reference:

1. David B F Johnson, Jianfeng Xu, Zhouxin Shen, Jeffrey K Takimoto, Matthew D Schultz, Robert J Schmitz, Zheng Xiang, Joseph R Ecker, Steven P Briggs, Lei Wang. **RF1 knockout allows ribosomal incorporation of unnatural amino acids at multiple sites**. *Nature Chemical Biology*, 2011; DOI: 10.1038/nchembio.657

http://www.sciencedaily.com/releases/2011/09/110921172851.htm

Scientists Play Ping-Pong With Single Electrons

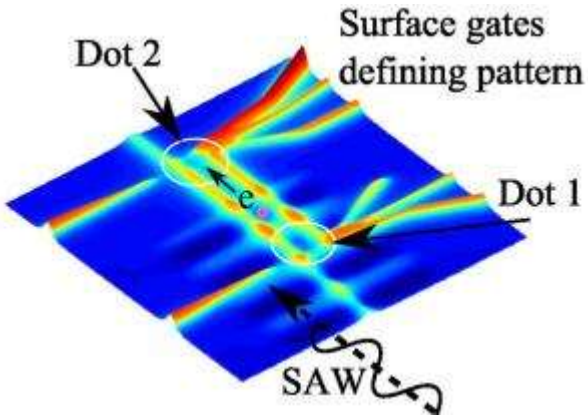


Illustration of the potential-energy landscape seen by an electron, and the potential wave produced by a sound pulse (surface acoustic wave, SAW) coming from bottom right and moving past the first dot, along the channel towards the other dot. (Credit: Image courtesy of University of Cambridge)

ScienceDaily (Sep. 22, 2011) — Scientists at Cambridge University have shown an amazing degree of control over the most fundamental aspect of an electronic circuit, how electrons move from one place to another.

Researchers from the University's Cavendish Laboratory have moved an individual electron along a wire, batting it back and forth over sixty times, rather like the ball in a game of ping-pong. The research findings, published September 22 in the journal *Nature*, may have applications in quantum computing, transferring a quantum 'bit' between processor and memory, for example.

Imagine you are at a party and you want to get to the other side of a crowded room to talk to someone. As you walk you have to weave around people who are walking, dancing or just standing in the way. You may also have to stop and greet friends along the way and by the time you reach the person you wanted to talk to you have forgotten what you were going to say. Wouldn't it be nice to be lifted up above the crowd, and pushed directly to your destination?

In a similar way, electrons carrying a current along a wire do not go directly from one end to the other but instead follow a complicated zigzag path. This is a problem if the electron is carrying information, as it tends to 'forget' it, or, more scientifically, the quantum state loses coherence.

In this work, a single electron can be trapped in a small well (called a quantum dot), just inside the surface of a piece of Gallium Arsenide (GaAs). A channel leads to another, empty, dot 4 microns (millionths of a metre) away. The channel is higher in energy than the surrounding electrons. A very short burst of sound (just a few billionths of a second long) is then sent along the surface, past the dot. The accompanying wave of electrical potential picks up the electron, which then surfs along the channel to the other dot, where it is captured. A burst of sound sent from the other direction returns the electron to the starting dot where the process can be repeated. The electron goes back and forth like a ping-pong ball. Rallies of up to 60 shots have been achieved before anything goes wrong.

"The movement of electrons by our 'surface acoustic wave' can also be likened to peristalsis in the esophagus, where food is propelled from the mouth to the stomach by a wave of muscle contraction," explains Rob McNeil, the PhD student who did most of the work, helped by postdoc Masaya Kataoka, both at the University of Cambridge's Department of Physics, the Cavendish Laboratory.

"This is an enabling technology for quantum computers," Chris Ford, team leader of the research from the Semiconductor Physics Group in the Cavendish, says. "There is a lot of work going on worldwide to make this new type of computer, which may solve certain complex problems much faster than classical computers. However, little effort has yet been put into connecting up different components, such as processor and memory. Although our experiments do not yet show that electrons 'remember' their quantum state, this is likely to be the case. This would make the method of transfer a candidate for moving quantum bits of information (qubits) around a quantum circuit, in a quantum computer. Indeed, our theorist, Crispin Barnes, proposed using this mechanism to make a whole quantum computer a long time ago, and this is an important step towards that goal."

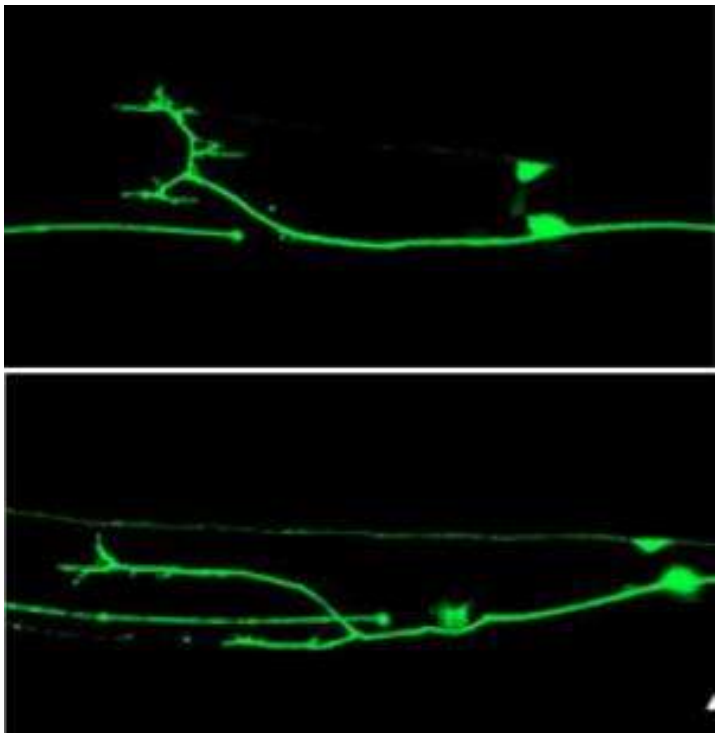
Story Source:

Journal Reference:

1. R. P. G. McNeil, M. Kataoka, C. J. B. Ford, C. H. W. Barnes, D. Anderson, G. A. C. Jones, I. Farrer, D. A. Ritchie. **On-demand single-electron transfer between distant quantum dots**. *Nature*, 2011; 477 (7365): 439 DOI: 10.1038/nature10444

http://www.sciencedaily.com/releases/2011/09/110921134529.htm

Biologists Discover Genes That Repair Nerves After Injury



Regrowing axons 12 hours (top) and 24 hours (bottom) after injury. (Credit: Lizhen Chen, UC San Diego)

ScienceDaily (Sep. 22, 2011) — Biologists at the University of California, San Diego have identified more than 70 genes that play a role in regenerating nerves after injury, providing biomedical researchers with a valuable set of genetic leads for use in developing therapies to repair spinal cord injuries and other common kinds of nerve damage such as stroke.

In the September 22 issue of the journal *Neuron*, the scientists detail their discoveries after an exhaustive two-year investigation of 654 genes suspected to be involved in regulating the growth of axons -- the thread-like extensions of nerve cells that transmit electrical impulses to other nerve cells. From their large-scale genetic screen, the researchers identified 70 genes that promote axon growth after injury and six more genes that repress the re-growth of axons.

"We don't know much about how axons re-grow after they're damaged," said Andrew Chisholm, a professor of biology at UC San Diego. "When you have an injury to your spinal cord or you have a stroke you cause a lot of damage to your axons. And in your brain or spinal cord, regeneration is very inefficient. That's why spinal cord injuries are basically untreatable."

Chisholm and UC San Diego biology professor and HHMI Investigator Yishi Jin headed the collaborative research team, which also included researchers from the University of Oregon.

While scientists in recent decades have gained a good understanding of how nerve cells, or neurons, develop their connections in the developing embryo, much less is known about how adult animals and humans repair -- or fail to repair -- those connections when axons are damaged.

"There are many processes not involved in early development that are involved in switching the neurons to this re-growth mode," said Chisholm. "In essence what we found are genes that people had not suspected previously to be part of this process."

Of particular interest to the UC San Diego biologists are the six genes that appear to repress the growth of axons.

"The discovery of these inhibitors is probably the most exciting finding," said Chisholm, because identifying and eliminating the inhibiting factors to the re-growth of axons could be just as essential as the biochemical pathways that promote axon re-growth in repairing spinal cord injuries and other kinds of nerve damage.

The scientists were also surprised to learn that some of the genes they found to be involved in the re-growth of axons were known to have other functions, such as regulating the release of neurotransmitters.

"This was in large part unexpected," said Chisholm. "These genes had not been implicated in the re-growth of axons before."

To find the 76 genes, the researchers conducted painstaking experiments on more than 10,000 tiny laboratory roundworms known as *C. elegans*. The first step involved developing genetic mutants of these transparent roundworms for each one of 654 genes that were suspected to play a role in the regulation of axon regrowth in worms, fruit flies and mice. They then labeled the roundworm neurons with green fluorescent protein and, with a precise surgical laser, damaged a specific axon.

"The goal was to study this process in its simplest form," said Chisholm. "Because the animals are essentially transparent, we can see the axons expressing this green fluorescent protein."

By examining the re-growth, or lack of growth, of the damaged axon 24 hours later, the scientists were then able to determine which of these 654 genes were actually important to axon re-growth.

Chisholm said that while the 76 genes identified are believed to have similar roles in mammals as well as roundworms, because their functions were "conserved" by the organisms through evolution, he and his research team are now collaborating with other investigators to conduct experiments on mice to verify this connection and determine which of these genes are the most critically important.

"Worms are clearly different from mammals," he added. "But there will be a core of conserved molecules doing the same job."

In addition to Chisholm and Jin, the UC San Diego biologists involved in the study were Lizhen Chen, Zhiping Wang, Anindya Ghosh-Roy, Thomas Hubert, Dong Yan, and Zilu Wu. Sean O'Rourke and Bruce Bowerman from the University of Oregon were also part of the team.

The research project was supported by grants from the National Institutes of Health and the Howard Hughes Medical Institute.

Story Source:

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

Journal Reference:

1. Lizhen Chen, Zhiping Wang, Anindya Ghosh-Roy, Thomas Hubert, Dong Yan, Sean O'Rourke, Bruce Bowerman, Zilu Wu, Yishi Jin, Andrew D. Chisholm. **Axon Regeneration Pathways Identified by Systematic Genetic Screening in C. elegans**. *Neuron*, Volume 71, Issue 6, 1043-1057, 22 September 2011 DOI: 10.1016/j.neuron.2011.07.009

http://www.sciencedaily.com/releases/2011/09/110921144604.htm

Smells May Help Birds Find Their Homes, Avoid Inbreeding; Research May Bring Help to Endangered Species

Penguins may be able to smell if another penguin is a relative, a skill that is useful in avoiding inbreeding in densely populated colonies. (Credit: Photo by Jim Schulz/Chicago Zoological Society)

ScienceDaily (Sep. 22, 2011) — Birds may have a more highly developed sense of smell than researchers previously thought, contend scholars who have found that penguins may use smell to determine if they are related to a potential mate.

The research by the University of Chicago and the Chicago Zoological Society, which manages Brookfield Zoo, shows how related birds are able to recognize each other. The study, published Sept. 21 in the journal *PLoS ONE,* could help conservationists design programs to help preserve endangered species.

"Smell is likely the primary mechanism for kin recognition to avoid inbreeding within the colony," said Heather Coffin, lead author of the paper.

Coffin conducted the research while a graduate student at UChicago and was joined in writing the paper by Jill Mateo, associate professor in Comparative Human Development at UChicago, and Jason Watters, director of animal behavior research for the Chicago Zoological Society.

"This is the first study to provide evidence for odor-based kin discrimination in birds," said Mateo, who is a specialist on kin recognition.

Experts said the work offers important insights into how birds use smell to guide behavior.

"The work by the research group is truly groundbreaking in that it shows for the first time ever in birds how the olfactory sense of captive penguins is both informative and functional in a behaviorally critical context: namely the recognition of friends from foes in general, and relatives from non-relatives in particular," said Mark E. Hauber, professor of psychology at Hunter College, a specialist on bird social recognition.

Penguins are ideal subjects because they typically live in colonies made up of thousands of birds. They live in monogamous pairs -- an arrangement that facilitates rearing of their young, since parents frequently take turns leaving the nest to gather food. Despite the size of the community, mates are able to find each other after traveling for days foraging for food in the ocean.

Research on other sea birds has shown that smell helps guide birds to their home territory and helps them forage for food. Other research has shown that birds could use sound and sight to recognize each other, but no other studies have shown that smell might be used in connection with kin recognition, Mateo said.

In the study conducted at Brookfield Zoo, researchers first sought to determine if the penguins were able to recognize familiar individuals by smell. They constructed an experiment using a dozen penguins, from a group that included breeding pairs, their offspring and nonbreeding individuals. The birds -- all Humboldt penguins -- endangered natives of Peru -- were from groups either on exhibit or off exhibit.

The zoo is an ideal setting for the research, as it has extensive records on which penguins are related and have been housed together, Watters said.

Researchers took odor samples from glands near the penguins' tails, where an oil that the birds use for preening is secreted. They put the oil on cotton swabs and rubbed the odor inside dog kennels, similar to the enclosures penguins at a zoo use for their nests. They also put the odor on paper coffee filters and placed them under mats inside the kennels.

When the penguins were released to the area containing the kennels, the researchers found that penguins spent more time in the kennels with familiar odors. The penguins were able to distinguish between the odors of birds they spent time with and the odors of unfamiliar penguins.

"What I found particularly notable about the study was that the authors identified the oil secreted from the penguins' preen gland, which is rubbed on the feathers to make them water repellent, as the odor source used in recognition," said Bryan D. Neff, professor and associate chair of biology, University of Western Ontario and an expert on kin recognition. "Oils are used in kin recognition by species of other animals, most notably a variety of insect species, including bees and wasps, which when considered with the penguin data provide a wonderful example of convergent evolution."

"It's important for birds that live in large groups in the wild, like penguins, to know who their neighbors are so that they can find their nesting areas and also, through experience, know how to get along with the birds nearby," Watters said.

Because offspring usually return to the same colony for nesting, siblings have the potential of becoming mates, something that can be avoided by their smell mechanism, the new research shows.

Researchers also found that when the birds were exposed to the odors of unfamiliar kin and unfamiliar non-kin, they spent more time in the kennels with odors of unfamiliar non-kin, indicating they were probably able to determine by smell which animals they were related to and were more curious about the novel odors. Being able to make the distinction may help the penguins avoid mating with kin, researchers said. The discovery also could assist zoos in managing their breeding programs.

"It could also be true that birds may be able to help zoo 'matchmakers' in determining potential mates," Watters said.

The ability of birds to be able to recognize familiar scents and thus be guided to their home territory also has potential value to naturalists, he said.

"You could imagine that if you were trying to reintroduce birds to an area, you could first treat the area with an odor the birds were familiar with. That would make them more likely to stay."

Story Source:

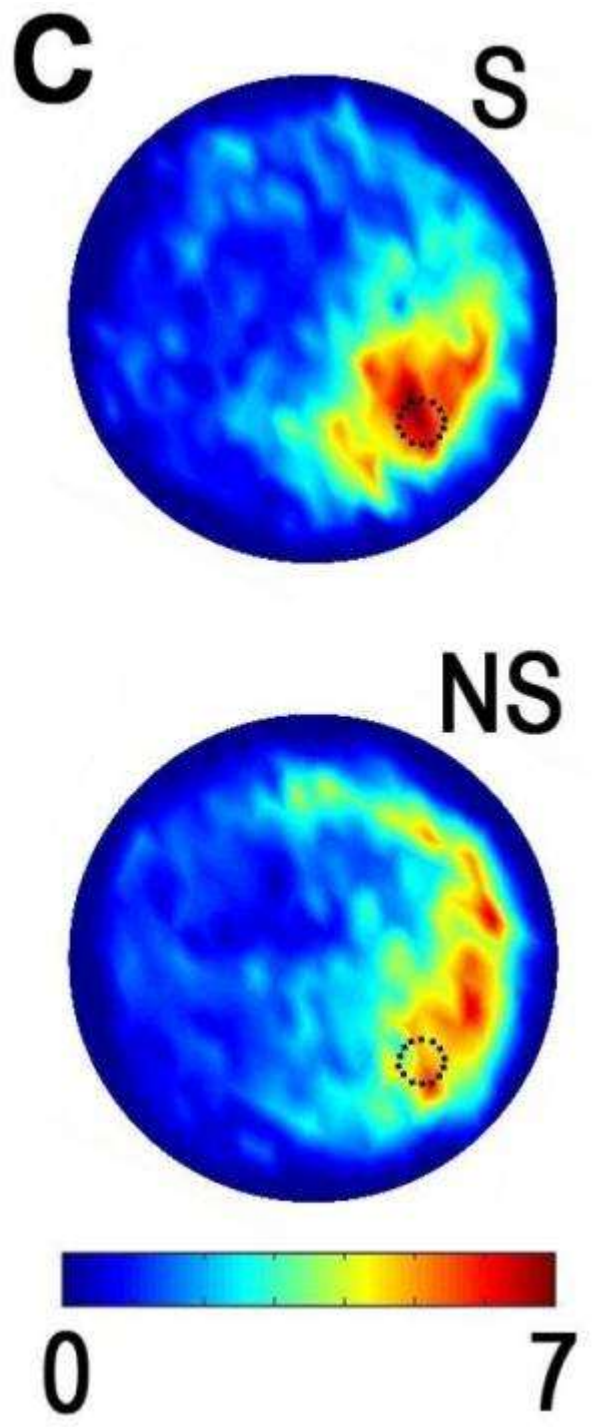
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Chicago**. The original article was written by William Harms.

Journal Reference:

1. Heather R. Coffin, Jason V. Watters, Jill M. Mateo. **Odor-Based Recognition of Familiar and Related Conspecifics: A First Test Conducted on Captive Humboldt Penguins (Spheniscus humboldti)**. *PLoS ONE*, 2011; 6 (9): e25002 DOI: 10.1371/journal.pone.0025002

http://www.sciencedaily.com/releases/2011/09/110921172834.htm

Electrical Stimulation of Brain Boosts Birth of New Cells: Animal Study Suggests Deep Brain Stimulation Improves Memory



Mice who received deep brain stimulation (DBS) to a region in the brain called the entorhinal cortex showed an enhanced ability to learn how to navigate to a designated target. This image shows DBS mice (S) spent a greater amount of time (indicated in red) swimming near a submerged landing (dotted circle) compared with non-stimulated mice (NS). (Credit: Reprinted with permission: Stone, et al. The Journal of Neuroscience 2011)

ScienceDaily (Sep. 22, 2011) — Stimulating a specific region of the brain leads to the production of new brain cells that enhance memory, according to an animal study in the September 21 issue of *The Journal of Neuroscience*. The findings show how deep brain stimulation (DBS) -- a clinical intervention that delivers electrical pulses to targeted areas of the brain -- may work to improve cognition.

"DBS has been quite effective for the treatment of movement disorders, such as Parkinson's disease, and has recently been explored for treatment of a range of neurologic and psychiatric conditions," said Paul Frankland, PhD, of The Hospital for Sick Children (SickKids), senior author of the study. "These new findings have important clinical implications as they inform potential treatments for humans with memory disorders."

Throughout life, new cells are born in parts of the hippocampus, the brain's learning and memory center. In the new study, Frankland and his colleagues found that one hour of electrical stimulation to the entorhinal cortex -- a region that directly communicates with the hippocampus -- in adult mice led to a two-fold increase in new cells in the hippocampus. Although the burst of new cells lasted for only about one week, the cells produced during this time window developed normally and made connections with other nearby brain cells.

Six weeks later, the researchers evaluated whether the newly integrated cells produced changes in

memory. The authors tested how well the animals learned to navigate onto a landing submerged in a small pool of water. Compared with mice that did not receive the therapy, DBS mice spent more time swimming near the landing, suggesting that stimulation of the entorhinal cortex improved spatial learning.

"To date, the neurobiological basis for the clinical effect of DBS has not been well understood," said Daniel A. Peterson, PhD, of the Rosalind Franklin University of Medicine and Science, an expert on stem cells and brain repair who was unaffiliated with the study. "This study suggests that the stimulation of specific brain circuitry may result in the development of new functional brain cells in particular brain regions."

In a related preliminary study, researchers led by Andres Lozano, MD, PhD, of Toronto Western Hospital, recently published a Phase I clinical trial showing that DBS of the fornix, a brain region that also communicates directly with the hippocampus, slows cognitive decline in some people with dementia and other cognitive impairments. "The pro-cognitive effects of deep brain stimulation in human patients may result from the production of new neurons," Frankland said.

The research was supported by the Canadian Institutes of Health Research.

Story Source:

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

Journal Reference:

1. S. S. D. Stone, C. M. Teixeira, L. M. DeVito, K. Zaslavsky, S. A. Josselyn, A. M. Lozano, P. W. Frankland. **Stimulation of Entorhinal Cortex Promotes Adult Neurogenesis and Facilitates Spatial Memory**. *Journal of Neuroscience*, 2011; 31 (38): 13469 DOI: 10.1523/JNEUROSCI.3100-11.2011

http://www.sciencedaily.com/releases/2011/09/110920173345.htm

Targeting HIV's Sugar Coating: New Microbicide May Block AIDS Virus from Infecting Cells

Bioengineer Patrick Kiser has discovered a new class of compounds that stick to the AIDS virus' sugary coating to prevent it from infecting cells. The new substances may provide a way to prevent sexual transmission of the virus. (Credit: University of Utah)

ScienceDaily (Sep. 22, 2011) — University of Utah researchers have discovered a new class of compounds that stick to the sugary coating of the AIDS virus and inhibit it from infecting cells -- an early step toward a new treatment to prevent sexual transmission of the virus.

Development and laboratory testing of the potential new microbicide to prevent human immunodeficiency virus infection is outlined in a study set for online publication in the journal *Molecular Pharmaceutics*.

Despite years of research, there is only one effective microbicide to prevent sexual transmission of HIV, which causes AIDS, or acquired immune deficiency syndrome. Microbicide development has focused on gels and other treatments that would be applied vaginally by women, particularly in Africa and other developing regions.

To establish infection, HIV must first enter the cells of a host organism and then take control of the cells' replication machinery to make copies of itself. Those HIV copies in turn infect other cells. These two steps of the HIV life cycle, known as viral entry and viral replication, each provide a potential target for anti-AIDS medicines.

"Most of the anti-HIV drugs in clinical trials target the machinery involved in viral replication," says the study's senior author, Patrick F. Kiser, associate professor of bioengineering and adjunct associate professor of pharmaceutics and pharmaceutical chemistry at the University of Utah.

"There is a gap in the HIV treatment pipeline for cost-effective and mass-producible viral entry inhibitors that can inactivate the virus before it has a chance to interact with target cells," he says.

Kiser conducted the study with Alamelu Mahalingham, a University of Utah graduate student in pharmaceutics and pharmaceutical chemistry; Anthony Geonnotti of Duke University Medical Center in Durham, N.C.; and Jan Balzarini of Catholic University of Leuven in Belgium.

The research was funded by the National Institutes of Health, the Bill and Melinda Gates Foundation, the Catholic University of Leuven, Belgium, and the Fund for Scientific Research, also in Belgium.

Synthetic Lectins Inhibit HIV from Entering Cells

Lectins are a group of molecules found throughout nature that interact and bind with specific sugars. HIV is coated with sugars that help to hide it from the immune system. Previous research has shown that lectins derived from plants and bacteria inhibit the entry of HIV into cells by binding to sugars found on the envelope coating the virus.

However, the cost of producing and purifying natural lectins is prohibitively high. So Kiser and his colleagues developed and evaluated the anti-HIV activity of synthetic lectins based on a compound called benzoboroxole, or BzB, which sticks to sugars found on the HIV envelope.

Kiser and his colleagues found that these BzB-based lectins were capable of binding to sugar residues on HIV, but the bond was too weak to be useful. To improve binding, they developed polymers of the synthetic lectins. The polymers are larger molecules made up of repeating subunits, which contained multiple BzB binding sites. The researchers discovered that increasing the number and density of BzB binding sites on the synthetic lectins made the substances better able to bind to the AIDS virus and thus have increased antiviral activity.

"The polymers we made are so active against HIV that dissolving about one sugar cube's weight of the benzoboroxole polymer in a bath tub of water would be enough to inhibit HIV infection in cells," says Kiser.

Depending on the strain, HIV displays significant variations in its viral envelope, so it is important to evaluate the efficacy of any potential new treatment against many different HIV strains.

Kiser and his colleagues found that their synthetic lectins not only showed similar activity across a broad spectrum of HIV strains, but also were specific to HIV and didn't affect other viruses with envelopes.

The scientists also tested the anti-HIV activity of the synthetic lectins in the presence of fructose, a sugar present in semen, which could potentially compromise the activity of lectin-based drugs because it presents an alternative binding site. However, the researchers found that the antiviral activity of the synthetic lectins was fully preserved in the presence of fructose.

"The characteristics of an ideal anti-HIV microbicide include potency, broad-spectrum activity, selective inhibition, mass producibility and biocompatibility," says Kiser. "These benzoboroxole-based synthetic lectins seem to meet all of those criteria and present an affordable and scalable potential intervention for preventing sexual transmission in regions where HIV is pandemic."

Kiser says future research will focus on evaluating the ability of synthetic lectins to prevent HIV transmission in tissues taken from the human body, with later testing in primates. Kiser and his colleagues are also developing a gel form of the polymers, which could be used as a topical treatment for preventing sexual HIV transmission.

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

Journal Reference:

1. Alamelu Mahalingam, Anthony R Geonnotti, Jan Balzarini, Patrick Franklin Kiser. **Activity and Safety of Synthetic Lectins Based on Benzoboroxole-Functionalized Polymers for Inhibition of HIV Entry**. *Molecular Pharmaceutics*, 2011; 110831135436035 DOI: 10.1021/mp2002957

http://www.sciencedaily.com/releases/2011/09/110923095814.htm

DNA Study Suggests Asia Was Settled in Multiple Waves of Migration

To extract DNA from a fossilized bone, researchers extract material using a dentistry drill. (Credit: Image courtesy of the National Science Foundation)

ScienceDaily (Sep. 22, 2011) — An international team of researchers studying DNA patterns from modern and archaic humans has uncovered new clues about the movement and intermixing of populations more than 40,000 years ago in Asia.

Using state-of-the-art genome analysis methods, scientists from Harvard Medical School and the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, have found that Denisovans -- a recently identified group of archaic humans whose DNA was extracted last year from a finger bone excavated in Siberia -- contributed DNA not just to present-day New Guineans, but also to aboriginal Australian and Philippine populations.

The study demonstrates that contrary to the findings of the largest previous genetic studies, modern humans settled Asia in more than one migration. According to David Reich, a professor of genetics at Harvard Medical School, "Denisova DNA is like a medical imaging dye that traces a person's blood vessels. It is so recognizable that you can detect even a little bit of it in one individual. In a similar way, we were able to trace Denisova DNA in the migrations of people. This shows the power of sequencing ancient DNA as a tool for understanding human history."

The patterns the researchers found can only be explained by at least two waves of human migration: the first giving rise to the aboriginal populations that currently live in Southeast Asia and Oceania, and later migrations giving rise to relatives of East Asians who now are the primary population of Southeast Asia.

The study also provides new insights about where the ancient Denisovans lived. According to Mark Stoneking, a professor at the Max Planck Institute who is senior author of the paper, Denisovans must have inhabited an extraordinarily large ecological and geographic range, from Siberia to tropical Southeast Asia. "The fact that Denisovan DNA is present in some aboriginal populations of Southeast Asia but not in others

shows that there was a checkerboard of populations with and without Denisova material more than 44,000 years ago," he said. "The presence of Denisovan genetic material in some but not all the groups there can most easily be explained if Denisovans lived in Southeast Asia itself."

The findings appear on September 22 in the *American Journal of Human Genetics*.

This research builds on previous work by Reich and colleagues at the Max Planck Institute, in which they analyzed an ancient pinky bone uncovered by Russian archaeologists in the Siberian Denisova Cave in 2008. The Max Planck Institute team led by Svante Pääbo sequenced the bone's nuclear genome, and Reich led the population genetic analysis using algorithms that he and colleagues developed.

Reporting December 2010 in *Nature*, the team identified Denisovans as a distinct group of archaic humans (hominins) that lived more than 30,000 years ago and contributed genes to present-day New Guineans. They concluded that Denisovans were neither Neandertals nor early modern humans, though they shared a common ancestry.

This paper helped fill in some empty pieces in the evolutionary puzzle that began after early humans left Africa and reinforces the view that humans have intermixed throughout history.

Genetic footprints

The new study was initiated by Stoneking, an expert on genetic variation in Southeast Asia and Oceania who has assembled diverse samples from that region. The study takes a closer look at the Denisovans' genetic footprint. The researchers analyzed DNA from dozens of present-day populations in Southeast Asia and Oceania, including Borneo, Fiji, Indonesia, Malaysia, Australia, the Philippines, Papua New Guinea and Polynesia. Some of the data already existed, and some were newly collected for the study.

Their analysis shows that, in addition to New Guineans, Denisovans contributed genetic material to Australian aborigines, a Philippine "Negrito" group called Mamanwa, and several other populations in eastern Southeast Asia and Oceania. However, groups in the west or northwest, including other Negrito groups such as the Onge in the Andaman Islands and the Jehai in Malaysia, as well as mainland East Asians, did not interbreed with Denisovans.

The researchers concluded that:

- Denisovans interbred with modern humans in Southeast Asia at least 44,000 years ago before the time of the separation of the Australians and New Guineans.
- Southeast Asia was first colonized by modern humans unrelated to present-day Chinese and Indonesians, and that these and other East Asians arrived in later migrations. This "southern route" hypothesis has previously been supported by archaeological evidence, but has never had strong genetic support.

Investigators from the Broad Institute of MIT and Harvard, from Germany, India, Taiwan, Japan, Malaysia, and The Netherlands also contributed. This study was funded by the Max Planck Society and the National Science Foundation HOMINID program.

Story Source:

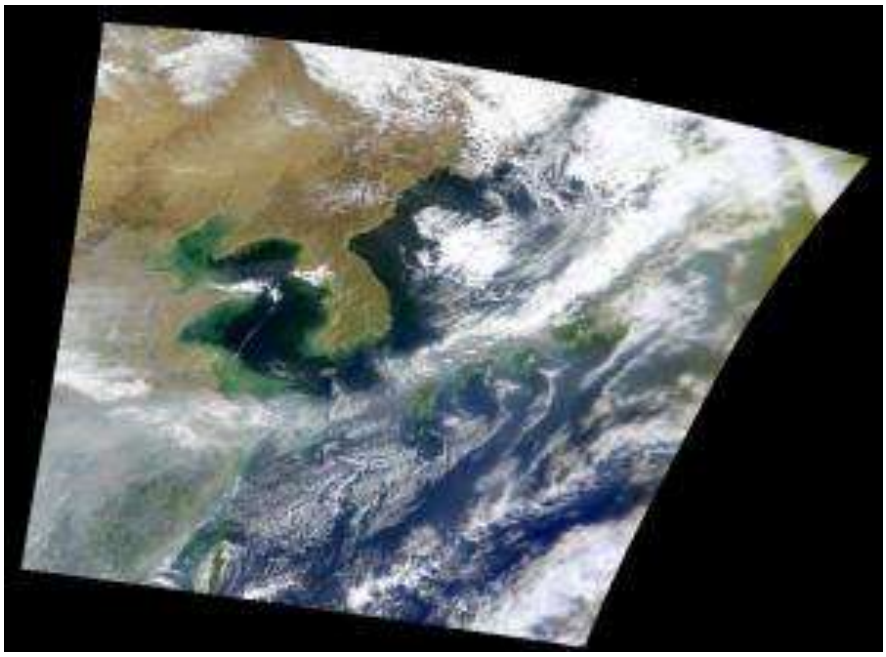
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Harvard Medical School**. The original article was written by Debra Ruder.

Journal Reference:

1. David Reich, Nick Patterson, Martin Kircher, Frederick Delfin, Madhusudan R. Nandineni, Irina Pugach, Albert Min-Shan Ko, Ying-Chin Ko, Timothy A. Jinam, Maude E. Phipps et al. **Denisova Admixture and the First Modern Human Dispersals into Southeast Asia and Oceania**. *American Journal of Human Genetics*, September 22, 2011 DOI: 10.1016/j.ajhg.2011.09.005

http://www.sciencedaily.com/releases/2011/09/110922121405.htm

Nitrate Levels Rising in Northwestern Pacific Ocean



Yellow Sea. The area studied included the Yellow Sea, the Sea of Japan and the East China Sea. The researchers found that the phosphorus levels in the ocean water remained the same through time. (Credit: MODIS Data/NASA)

ScienceDaily (Sep. 22, 2011) — Changes in the ratio of nitrate to phosphorus in the oceans off the coasts of Korea and Japan caused by atmospheric and riverine pollutants may influence the makeup of marine plants and influence marine ecology, according to researchers from Korea and the U. S.

"Normally in a marine environment nitrate is the limiting factor, but increased nitrate in the ocean can spur growth and create a situation where phosphorus becomes the nutrient in short supply," says Raymond G. Najjar, professor of oceanography, Penn State. "This change in nutrients could favor organisms that are better suited for high nitrate and low phosphorus."

According to the researchers, the effects of anthropogenic nitrate pollution from the air have been shown to be significant in local lakes, streams and estuaries in Norway, Sweden and the U.S.

"This is the first evidence of increases in nitrate in ocean waters not in an enclosed estuary like the Chesapeake Bay," said Najjar. "These are large, very deep bodies of water and it is surprising to see increased nitrate in these large seas."

Najjar and his Korean colleagues, Kitack Lee, professor, and Tae-Wook Kim, graduate student, School of Environmental Science and Engineering, Pohang University of Science and Technology; Hee-Dong Jeong, National Fisheries Research and Development Institute; and Hae Jun Jeong, professor, School of Earth and Environmental Science, Seoul National University, studied trends in nitrate and phosphate in the coastal waters of Korea and Japan since the 1980s. They also compared the amount of nitrogen deposited from the air between 2002 and 2008 for Korea and Japan with the amounts of nitrate in the water during that same time period to show that the increased levels in the water are directly correlated to an increase in human-generated atmospheric nitrogen.

The area studied included the Yellow Sea, the Sea of Japan and the East China Sea. The researchers found that the phosphorus levels in the ocean water remained the same through time.

"The abundance of nitrogen relative to phosphorus in northeastern Asian marginal seas has increased significantly since 1980," the researchers report in the Sepembert 23 online edition of *Science* Express. "Anthropogenic atmospheric nitrogen deposition has narrowed the deficiency of nitrogen relative to phosphorus across the study area and has even resulted in a nitrogen surplus in the East China Sea, Yellow Sea and East Sea, commencing in the mid-1990s."

The other source of nitrate into the oceans is from runoff from industry and agriculture that reaches the seas via rivers. In most cases, this nitrogen is quickly diluted.

"In areas located downstream of the Changjian River plume, contributions from both anthropogenic atmospheric nitrogen and riverine nitrogen fluxes appeared to be of equal importance in governing trends in seawater nitrate," the researchers report.

The researchers also looked at the area in the North Pacific on the south and east of Japan, but while nitrate in these waters did increase slightly, the increase was not significant except close to the Japanese coast. The highest level of increase seen was in the Yellow Sea east of China, where the Changjian River enters the sea. Other areas of significantly increased nitrates include the area east of the Korean peninsula and an area in the north of Japan south of Sapporo.

The researchers suggest that their results have broader applicability. "The observed trends may be extrapolated to the coastal seas of the North American Atlantic Ocean and the North, Baltic and Mediterranean Seas, which have received ever-increasing amounts of anthropogenic atmospheric nitrate deposition and river-borne nitrate, comparable to those absorbed by coastal and marginal seas of the northwestern Pacific Ocean."

NASA, the Korea National Research Foundation and the Korea Meteorological Administration Research and Development Program supported this work.

Story Source:

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

Journal Reference:

Tae-Wook Kim, Kitack Lee, Raymond G. Najjar, Hee-Dong Jeong, and Hae Jin Jeong. **Increasing N Abund**

http://www.sciencedaily.com/releases/2011/09/110922141912.htm

Using Human Genomes to Illuminate the Mysteries of Early Human History

The study shows that the San people -- like the man shown here -- split from other African populations about 130,000 years ago. (Credit: iStockphoto/Giuseppe Masci)

ScienceDaily (Sep. 21, 2011) — Cornell researchers have developed new statistical methods based on the complete genome sequences of people alive today to shed light on events at the dawn of human history.

They applied their methods to the genomes of individuals of East Asian, European, and western and southern African descent. They analyzed only six genomes, but made use of the fact that these genomes contain traces of genetic material from thousands of human ancestors, which have been assembled into new combinations over the millennia by genetic recombination.

The main finding of the study, published Sept. 18 in *Nature Genetics*, is that the San, an indigenous group of hunter gatherers from southern Africa, diverged from other human populations earlier than previously thought -- about 130,000 years ago. In comparison, the ancestors of modern Eurasian populations migrated from Africa only about 50,000 years ago.

Previous studies of human demography have primarily relied on mitochondrial DNA from the maternal line or Y-chromosome data passed from fathers to their sons, but those studies are limited by small numbers of genomic positions. This study uses the full genome of each individual, providing a richer, more complete picture of human evolution, according to the researchers.

"The use of genomewide data gives you much more confidence that you are getting the right answer," said Adam Siepel, associate professor of biological statistics and computational biology, and senior author of the paper. "With mitochondrial DNA, you are only looking at one family tree [the maternal line], with one pathway from each individual to its ancestors. We are sampling from all possible pathways."

"What's unusual about our methods is that, not only do they use complete genome sequences, but they consider several populations at once," said Ilan Gronau, the paper's lead author and a postdoctoral associate in Siepel's lab. "This is the first paper to put all of these pieces together," he added.

Previous studies using mitochondrial DNA, Y chromosomes and other markers have estimated that anatomically, modern humans arose roughly 200,000 years ago in eastern or southern Africa; and that the indigenous hunting-and-gathering central and southern African San people -- one of the most genetically divergent human populations -- diverged from other Africans about 100,000 years ago.

But this study shows that the San people split from other African populations about 130,000 years ago (somewhere between 108,000 and 157,000 years ago). The estimate of an "out of Africa" migration of about

50,000 years ago (somewhere between 38,000 and 64,000 years ago) is consistent with recent findings using other methods, the researchers said.

To conduct the study, the researchers began with a statistical approach that was originally developed to infer divergence times for related but distinct species, such as the human, chimpanzee and gorilla. They faced a number of challenges in adapting these methods for use with human genome sequences. For example, the great ape genome method assumes that gene flow stops after two species diverge, because they can no longer mate. That is not true for distinct human populations, and without accounting for gene flow, the divergence times would have been underestimated, Siepel said.

Gronau used mathematical techniques to work around that problem and then created elaborate computer simulations to demonstrate that the new method worked within known parameters of human divergence.

The study was funded by the Packard Foundation, National Science Foundation and National Institutes of Health.

Story Source:

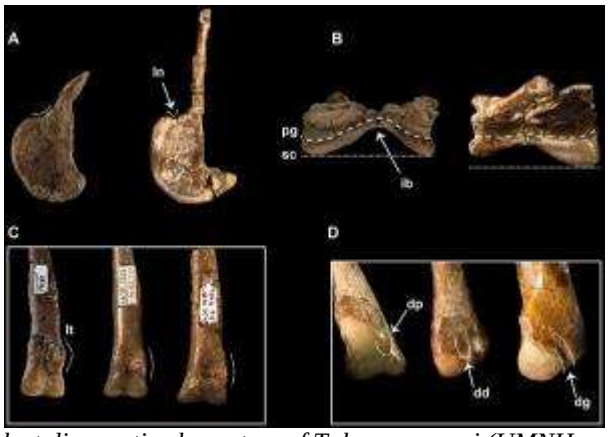
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Cornell University**. The original article was written by Krishna Ramanujan.

Journal Reference:

1. Ilan Gronau, Melissa J Hubisz, Brad Gulko, Charles G Danko, Adam Siepel. **Bayesian inference of ancient human demography from individual genome sequences**. *Nature Genetics*, 2011; DOI: 10.1038/ng.937

http://www.sciencedaily.com/releases/2011/09/110921120122.htm

Scientists Discover Rare Theropod Dinosaur Wounded in Action in Southern Utah



Skeletal elements of Talos and Troodon illustrating select diagnostic characters of Talos sampsoni (UMNH VP 19479). (Credit: Zanno LE, Varricchio DJ, O'Connor PM, Titus AL, Knell MJ (2011) A New Troodontid Theropod, Talos sampsoni gen. et sp. nov., from the Upper Cretaceous Western Interior Basin of North America. PLoS ONE 6(9): e24487. doi:10.1371/journal.pone.0024487)

ScienceDaily (Sep. 21, 2011) — Raptor dinosaurs like the iconic Velociraptor from the movie franchise Jurassic Park are renowned for their "fear-factor." Their terrifying image has been popularized in part because members of this group possess a greatly enlarged talon on their foot -- analogous to a butcher's hook. Yet the function of the highly recurved claw on the foot of raptor dinosaurs has largely remained a mystery to paleontologists. This week a collaboration of scientists unveil a new species of raptor dinosaur discovered in southern Utah that sheds new light on this and several other long-standing questions in paleontology, including how dinosaurs evolved on the "lost continent" of Laramidia (western North America) during the Late Cretaceous -- a period known as the zenith of dinosaur diversity.

Their findings will be published in the journal *PLoS ONE*.

The new dinosaur -- dubbed Talos sampsoni -- is a member of a rare group of feathered, bird-like theropod dinosaurs whose evolution in North America has been a longstanding source of scientific debate, largely for lack of decent fossil material. Indeed, Talos represents the first definitive troodontid theropod to be named from the Late Cretaceous of North America in over 75 years. "Finding a decent specimen of this type of dinosaur in North America is like a lighting strike… it's a random event of thrilling proportions," said Lindsay Zanno, lead author of the study naming the new dinosaur. Zanno is an assistant professor of anatomy at the University of Wisconsin-Parkside and a research associate at the Field Museum of Natural History in Chicago, Illinois. Other members of the research team include Mike Knell (a graduate student at Montana State University) who discovered the new specimen in 2008 in the Kaiparowits Formation of Grand Staircase-Escalante National Monument (GSENM), southern Utah; Bureau of Land Management (BLM) paleontologist Alan Titus, leader of a decade-long paleontology reconnaissance effort in the monument; David Varricchio, Associate Professor of Paleontology, Montana State University; and Patrick O'Connor, Associate Professor of Anatomy, Ohio University Heritage College of Osteopathic Medicine.

Funding for the research was provided in part by the National Science Foundation, the Field Museum of Natural History, the Ohio University Heritage College of Osteopathic Medicine, and the Bureau of Land Management. Zanno's research was supported by a John Caldwell-Meeker Fellowship and by a Bucksbaum Fellowship for young scientists. The bones of Talos sampsoni will be on exhibit for the first time in the Past Worlds Observatory at the new Utah Museum of Natural History, Salt Lake City, Utah.

The Nature of the Beast Troodontid theropods are a group of feathered dinosaurs closely related to birds. Members of this group are among the smallest non-avian dinosaurs known (as small as 100 grams) and are considered among the most intelligent. The group is known almost exclusively from Asia and prior to the discovery of Talos sampsoni, only two species were recognized in the Late Cretaceous of North America -- one of which, the infamous Troodon, was one of the first dinosaurs ever named from North America. As a result of their distinctive teeth and the possible presence of seeds preserved as gut contents in one species, several scientists have proposed an omnivorous or herbivorous diet for at least some troodontids. Other species possess relatively blade-like teeth indicative of a carnivorous diet. Zanno's own work on theropod diet suggests that extensive plant eating was confined to more primitive members of the group, with more advanced members of the clade like Troodon and Talos likely consuming at least some prey.

Several troodontid specimens have recently been discovered that not only support a close relationship with birds but also preserve remarkable evidence of bird-like behavior. These include extraordinary specimens such as eggs and embryos within nests that document transitional phases in the evolution of bird-like reproductive physiology and egg-laying behavior, as well as specimens preserved in distinctive avian-like sleeping postures with their heads rotated back and tucked under their "wings." Other troodontids provide evidence of "four-winged" locomotor capabilities, and perhaps most extraordinary, plumage coloration.

With an estimated body mass of 38 kilograms, the newly discovered Talos sampsoni is neither the smallest nor largest troodontid known. Its skeleton indicates that the new species was much smaller and more slender than its famous cousin Troodon, which is known from sediments of the same age in the northern part of Laramidia (Alberta, Canada and Montana, USA). "Talos was fleet-footed and lightly built," Zanno says. "This little guy was a scrapper."

Interestingly, the holotype specimen of Talos also tells us something about theropod behavior, particularly raptor behavior. This is because the second toe -- that is, the one with the enlarged talon -- of the left foot of the new specimen is deformed, indicating that the animal suffered a fracture or bite during its life.

This Little Talos Takes a Beating

When the team first began studying the Talos specimen, they noticed some unusual features on the second digit of the left foot, but initially assumed they were related to the fact that it belonged to a new species. "When we realized we had evidence of an injury, the excitement was palpable," Zanno commented. "An injured specimen has a story to tell." That's because evidence of injury relates to function. The manner in which an animal is hurt can tell you something about what it was doing during life. An injury to the foot of a raptor dinosaur, for example, provides new evidence about the potential function of that toe and claw. In order to learn about the injury to the animal's foot, the team scanned the individual bones using a high-resolution Computed Tomography (CT) scanner, similar to those used by physicians to examine bones and other organs inside the human body.

"Although we could see damage on the exterior of the bone, our microCT approach was essential for characterizing the extent of the injury, and importantly, for allowing us to better constrain how long it had been between the time of injury and the time that this particular animal died," noted Patrick O'Connor, associate professor of anatomy at Ohio University. After additional CT scanning of other parts of the foot, Zanno and her team realized that the injury was restricted to the toe with the enlarged claw, and the rest of the foot was not impacted. More detailed study suggested that the injured toe was either bitten or fractured and then suffered from a localized infection.

"People have speculated that the talon on the foot of raptor dinosaurs was used to capture prey, fight with other members of the same species, or defend the animal against attack. Our interpretation supports the idea that these animals regularly put this toe in harm's way," says Zanno.

Perhaps even more interesting is the fact that the injured toe exhibits evidence of bone remodeling thought to have taken place over a period of many weeks to months, suggesting that Talos lived with a serious injury to the foot for quite a long time. "It is clear from the bone remodeling that this animal lived for quite some time after the initial injury and subsequent infection, and that whatever it typically did with the enlarged talon on the left foot, whether that be acquire prey or interact with other members of the species, it must have been capable of doing so fairly well with the one on the right foot," added O'Connor.

Trackways made by animals closely related to Talos suggest that they held the enlarged talon off the ground when walking. "Our data support the idea that the talon of raptor dinosaurs was not used for purposes as mundane as walking," Zanno commented. "It was an instrument meant for inflicting damage."

What's in a Name?

The name Talos pays homage to a mythological Greek figure of the same name, believed to have protected the island of Crete by throwing stones at invading ships. It is said that the Greek Talos, who was often depicted as a winged bronze figure, could run at lightening speed and circled the ancient island three times a day. The dinosaur Talos belongs to a group of theropods known to have feathery integument (and in some cases "wings"), lived on the small island continent of Laramidia or west North America during the Late Cretaceous, and was also a fast runner. The team chose the name Talos because of these similarities but also because the Greek Talos was said to have died from a wound to the ankle and it was clear that Talos had also suffered a serious wound to the foot. The species name "sampsoni" honors another famous figure -- Dr. Scott Sampson of the PBS series Dinosaur Train. Sampson, a research curator at the Utah Museum of Natural History and research faculty at the University of Utah, helped to spearhead a collaborative research effort known as the Kaiparowits Basin Project, a long-term research project that has been surveying and documenting the Late Cretaceous dinosaur fauna of the Kaiparowits Basin in southern Utah, with a focus on the Kaiparowits and Wahweap formations exposed in Grand Staircase-Escalante National Monument (GSENM). Thus far this effort has resulted in the discovery of up to a dozen new dinosaurs from GSENM that are challenging previous ideas regarding Late Cretaceous dinosaur evolution and diversity within Laramidia and spurring new ideas regarding dinosaur biogeography in the region.

A Tale of Two Continents

Dinosaurs of the Late Cretaceous were living in a greenhouse world. A warm and equitable global climate that was devoid of polar ice caps and above average spreading at mid-oceanic ridges caused massive flooding of low-lying continental areas and created expansive epicontinental seaways. In North America, a shallow seaway running from the Gulf of Mexico through to the Arctic Ocean divided the continent into two landmasses, East America (Appalachia) and West America (Laramidia) for several million years during the Late Cretaceous. It was during this time that the dinosaurs achieved their greatest diversity, and scientists have been working overtime to understand why. Take for example the dinosaurs of Laramidia. The natural assumption is that being large bodied, those dinosaurs that lived on the small island continent would have roamed the whole area. However, recent fossil discoveries, particularly new dinosaurs from the Kaiparowits Formation, tell us that the true pattern is exactly the opposite. Thus far the dinosaurs from the Kaiparowits Formation in southern Utah are entirely unique, even from those dinosaurs living just a few hundred miles to the north in what is now Montana and Alberta. Monument Paleontologist Alan Titus observed, "When we began looking in the remote Kaiparowits badlands we expected to see at least a few familiar faces. As it turns out, they are all new to science." And while recent discoveries from the Kaiparowits have substantiated this pattern for large-bodied herbivores like duck-bill and horned dinosaurs (for example Utahceratops), the pattern among small-bodied theropods was not clear. "We already knew that some of dinosaurs inhabiting southern Utah during the Late Cretaceous were unique," Zanno said, "but Talos tells us that the singularity of this ecosystem was not just restricted to one or two species. Rather, the whole area was like a lost world in and of itself."

A Monumental Discovery

Talos sampsoni is the newest member of a growing list of new dinosaur species that have been discovered in Grand Staircase Escalante National Monument (GSENM) in southern Utah. Former President Clinton founded the monument in 1996, in part to protect the world class paleontological resources entombed within its 1.9 million acres of unexplored territory. GSENM is one of the largest recently designated national monuments managed by the BLM, and one of the last pristine dinosaur graveyards in the US. The area has turned out to be a treasure trove of new dinosaur species, with at least 15 collected in just the past decade. Titus admits, "We had very few large fossils to substantiate the claim of 'World Class' paleontology when I started in 2000. Now, I feel GSENM could easily qualify as a world heritage site on the basis of its dinosaurs alone, dozens of which have been found preserving soft tissue." He also adds, "BLM support has been critical to the long term viability of the region's paleontology research and is paying off in countless ways both to the public and scientists."

Zanno, along with colleague Scott Sampson, named the first dinosaur from the monument -- Hagryphus giganteus -- in 2005. Hagryphus (widely touted in the press as the "turkey" dinosaur) is also a theropod dinosaur, but one that belongs to a different subgroup known as oviraptorosaurs (or egg thief reptiles). Other GSENM dinosaurs include five new horned dinosaurs including the recently described and bizarrely ornate Kosmoceratops and Utahceratops, three new duck-bill dinosaurs including the "toothy" Gryposaurus monumentensis, two new tyrannosaurs, as well as undescribed ankylosaurs (armored dinosaurs), marine reptiles, giant crocodyliforms, turtles, plants, and a host of other organisms.

The discovery of a new troodontid from the monument is the latest in a long string of incredible fossil discoveries from the area. "I was surprised when I learned that I had found a new dinosaur," Knell said. "It is a rare discovery and I feel very lucky to be part of the exciting research happening here in the monument." Knell stumbled across the remains of Talos sampsoni while scouring the badlands of the Kaiparowits Formation for fossil turtles as part of his dissertation research.

Work continues every year in GSENM and new, significant fossil finds are made every field season. Considering there are hundreds of thousands of acres of outcrop that have yet to be surveyed, it is no exaggeration to claim the region will remain an exciting research frontier for decades to come.

Story Source:

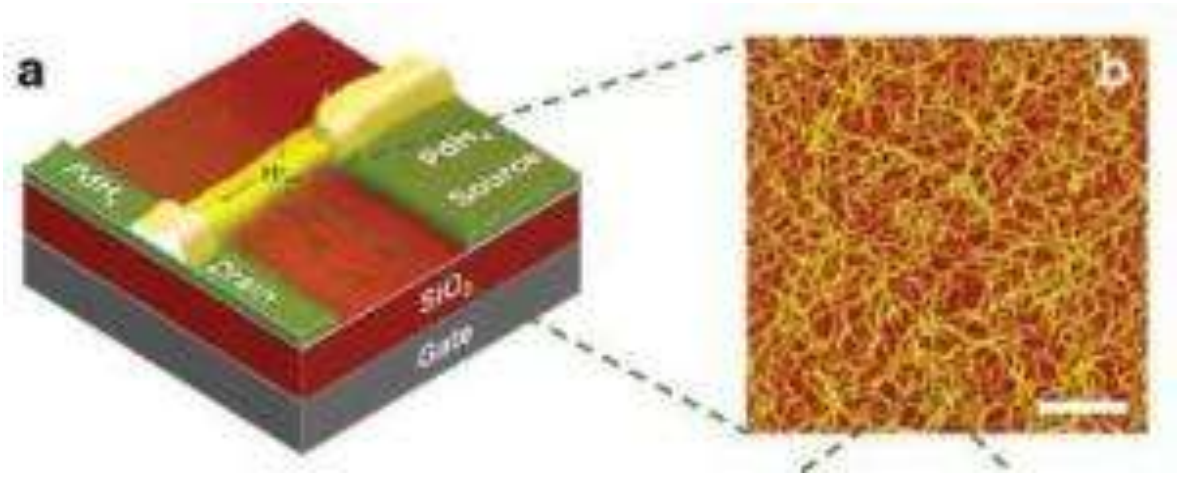
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Public Library of Science**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Lindsay E. Zanno, David J. Varricchio, Patrick M. O'Connor, Alan L. Titus, Michael J. Knell. **A New Troodontid Theropod, Talos sampsoni gen. et sp. nov., from the Upper Cretaceous Western Interior Basin of North America**. *PLoS ONE*, 2011; 6 (9): e24487 DOI: 10.1371/journal.pone.0024487

http://www.sciencedaily.com/releases/2011/09/110919171338.htm

Proton-Based Transistor Could Let Machines Communicate With Living Things



On the right is a colored photo of the University of Washington device overlaid on a graphic of the other components. On the right is a magnified image of the chitosan fibers. The white scale bar is 200 nanometers. (Credit: University of Washington)

ScienceDaily (Sep. 21, 2011) — Human devices, from light bulbs to iPods, send information using electrons. Human bodies and all other living things, on the other hand, send signals and perform work using ions or protons.

Materials scientists at the University of Washington have built a novel transistor that uses protons, creating a key piece for devices that can communicate directly with living things. The study is published online in the interdisciplinary journal *Nature Communications.*

Devices that connect with the human body's processes are being explored for biological sensing or for prosthetics, but they typically communicate using electrons, which are negatively charged particles, rather than protons, which are positively charged hydrogen atoms, or ions, which are atoms with positive or negative charge.

"So there's always this issue, a challenge, at the interface -- how does an electronic signal translate into an ionic signal, or vice versa?" said lead author Marco Rolandi, a UW assistant professor of materials science and engineering. "We found a biomaterial that is very good at conducting protons, and allows the potential to interface with living systems."

In the body, protons activate "on" and "off" switches and are key players in biological energy transfer. Ions open and close channels in the cell membrane to pump things in and out of the cell. Animals including humans use ions to flex their muscles and transmit brain signals. A machine that was compatible with a living system in this way could, in the short term, monitor such processes. Someday it could generate proton currents to control certain functions directly.

A first step toward this type of control is a transistor that can send pulses of proton current. The prototype device is a field-effect transistor, a basic type of transistor that includes a gate, a drain and a source terminal

for the current. The UW prototype is the first such device to use protons. It measures about 5 microns wide, roughly a twentieth the width of a human hair.

"In our device large bioinspired molecules can move protons, and a proton current can be switched on and off, in a way that's completely analogous to an electronic current in any other field effect transistor," Rolandi said.

The device uses a modified form of the compound chitosan originally extracted from squid pen, a structure that survives from when squids had shells. The material is compatible with living things, is easily manufactured, and can be recycled from crab shells and squid pen discarded by the food industry.

First author Chao Zhong, a UW postdoctoral researcher, and second author Yingxin Deng, a UW graduate student, discovered that this form of chitosan works remarkably well at moving protons. The chitosan absorbs water and forms many hydrogen bonds; protons are then able to hop from one hydrogen bond to the next.

Computer models of charge transport developed by co-authors M.P. Anantram, a UW professor of electrical engineering, and Anita Fadavi Roudsari at Canada's University of Waterloo, were a good match for the experimental results.

"So we now have a protonic parallel to electronic circuitry that we actually start to understand rather well," Rolandi said.

Applications in the next decade or so, Rolandi said, would likely be for direct sensing of cells in a laboratory. The current prototype has a silicon base and could not be used in a human body. Longer term, however, a biocompatible version could be implanted directly in living things to monitor, or even control, certain biological processes directly.

The other co-author is UW materials science and engineering graduate student Adnan Kapetanovic. The research was funded by the University of Washington, a 3M Untenured Faculty Grant, a National Cancer Institute fellowship and the UW's Center for Nanotechnology, which is funded by the National Science Foundation.

Story Source:

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

Journal Reference:

1. Chao Zhong, Yingxin Deng, Anita Fadavi Roudsari, Adnan Kapetanovic, M.P. Anantram, Marco Rolandi. **A polysaccharide bioprotonic field-effect transistor**. *Nature Communications*, 2011; 2: 476 DOI: 10.1038/ncomms1489

http://www.sciencedaily.com/releases/2011/09/110920111803.htm

Moral philosophy

Goodness has nothing to do with it
Utilitarians are not nice people

Sep 24th 2011 | from the print edition

A good man?

IN THE grand scheme of things Jeremy Bentham and John Stuart Mill are normally thought of as good guys. Between them, they came up with the ethical theory known as utilitarianism. The goal of this theory is encapsulated in Bentham's aphorism that "the greatest happiness of the greatest number is the foundation of morals and legislation."

Which all sounds fine and dandy until you start applying it to particular cases. A utilitarian, for example, might approve of the occasional torture of suspected terrorists—for the greater happiness of everyone else, you understand. That type of observation has led Daniel Bartels at Columbia University and David Pizarro at Cornell to ask what sort of people actually do have a utilitarian outlook on life. Their answers, just published in *Cognition*, are not comfortable.

One of the classic techniques used to measure a person's willingness to behave in a utilitarian way is known as trolleyology. The subject of the study is challenged with thought experiments involving a runaway railway trolley or train carriage. All involve choices, each of which leads to people's deaths. For example: there are five railway workmen in the path of a runaway carriage. The men will surely be killed unless the subject of the experiment, a bystander in the story, does something. The subject is told he is on a bridge over the tracks. Next to him is a big, heavy stranger. The subject is informed that his own body would be too light to stop the train, but that if he pushes the stranger onto the tracks, the stranger's large body will stop the train and save the five lives. That, unfortunately, would kill the stranger.

Dr Bartels and Dr Pizarro knew from previous research that around 90% of people refuse the utilitarian act of killing one individual to save five. What no one had previously inquired about, though, was the nature of the remaining 10%.

To find out, the two researchers gave 208 undergraduates a battery of trolleyological tests and measured, on a four-point scale, how utilitarian their responses were. Participants were also asked to respond to a series of statements intended to get a sense of their individual psychologies. These statements included, "I like to see fist fights", "The best way to handle people is to tell them what they want to hear", and "When you really think about it, life is not worth the effort of getting up in the morning". Each was asked to indicate, for each statement, where his views lay on a continuum that had "strongly agree" at one end and "strongly disagree" at the other. These statements, and others like them, were designed to measure, respectively, psychopathy, Machiavellianism and a person's sense of how meaningful life is.

Dr Bartels and Dr Pizarro then correlated the results from the trolleyology with those from the personality tests. They found a strong link between utilitarian answers to moral dilemmas (push the fat guy off the bridge) and personalities that were psychopathic, Machiavellian or tended to view life as meaningless. Utilitarians, this suggests, may add to the sum of human happiness, but they are not very happy people themselves.

That does not make utilitarianism wrong. Crafting legislation—one of the main things that Bentham and Mill wanted to improve—inevitably involves riding roughshod over someone's interests. Utilitarianism provides a plausible framework for deciding who should get trampled. The results obtained by Dr Bartels and Dr Pizarro do, though, raise questions about the type of people who you want making the laws. Psychopathic, Machiavellian misanthropes? Apparently, yes.

http://www.economist.com/node/21530078/print

The Tyranny Of Modern Time

by Adam Frank

Enlarge Susana Gonzalez/Getty Images

Living in the past: A man greets the spring equinox on top of a pyramid at Teotihuacan, Mexico.

This morning when you got up, did you feel anything different? As you rushed through getting your kids ready for school, grabbing breakfast and slogging through the morning commute, could you feel the celestial milestone you were passing? Probably not. And that is exactly why the crisis we face as individuals and as a society is so difficult to recognize.

The baseline crisis we must understand and confront is not one of economics, climate change, resource depletion or alternate-reality Republicans. Below them all is a crisis in time. Until we recognize it for what it is, we will be powerless to address the challenges surrounding us, hounding us.

Today is the autumnal equinox, when the hours of sunlight balance the hours of night. For most of human history the equinox — connected as it was to the harvest — was celebrated with elaborate festivals, rites and rituals. The equinox was a compass point. It was a mile marker for the *lived* year. Life was experienced through sky and season rather than through the construct of the clock. The equinox bound human communities together in a shared time that was both personal and cosmic.

Today hardly anyone notices the equinox. Today we rarely give the sky more than a passing glance. We live by precisely metered clocks and appointment blocks on our electronic calendars, feeling little personal or communal connection to the kind of time the equinox once offered us. Within that simple fact lays a tectonic shift in human life and culture.

Your time — almost entirely divorced from natural cycles — is a new time. Your time, delivered through digital devices that move to nanosecond cadences, has never existed before in human history. As we rush through our overheated days we can barely recognize this new time for what it really is: an invention.

It's an invention that's killing us.

We've come to accept the millisecond timing for computer-driven stock trades. We assume that "overnight" is an appropriate wait for an order of goods from China. We have been schooled to believe 15 minutes is what to expect for the length of a visit with the doctor. Most importantly, we have come to accept days crowded into attention-starved blocks of appointments, "to-dos" and play dates.

For all we have learned to "produce" with this new time, it is not sustainable. What we have built can't last in this form. It needs to change and *it can change*.

Like the balance embodied in the equinox, a balanced life and a balanced culture are both possible and necessary. In an act of cosmic irony tied closely to the celestial imperatives of the equinox, grand ideas coming out of science and cosmology are setting the stage for such a change.

Today, I begin a four-part series of posts — I'll try and do one each week — about the unspoken cultural assumptions defining time in our era. I will to start with physics and cosmology, then go further. The issue I want to address is how we have been trained to see and use time. I want to talk about how it stalks us, driving our lives and culture past sustainable limits.

This series will be based on research I did for my book that comes out next week, *About Time: Cosmology and Culture at the Twilight of the Big Bang*. The book includes a great deal about the history of cosmology and new ideas that are poised to replace the "big bang" (see last week's discussion on the end of the big bang). In this series of posts, however, I will focus mainly on human side of the equation: the history of the human experience of time.

We need to see how this time was created and how it ended up accelerating and compressing life in dangerous ways. Finally, we need to see how human constructions of time have changed in the past and how they can still change in future.

Let me start by asking you a simple question: What time is it right now?

To answer this query you probably looked at the clock on your computer or on your cell phone. It told you something like 9:12 a.m. or 11:22 a.m. or 1:37 p.m. But what is 1:37 p.m.? What is the meaning of such an exact metering of minutes?

Mechanical clocks for measuring hours did not appear until the fourteenth century. Minute hands on those clocks did not come into existence until 400 years later. Before these inventions the vast majority of human beings had no access to any form of timekeeping device. Sundials, water clocks and sandglasses did exist. But their daily use was confined to an elite minority.

In ancient Rome, for example, noon was called out by someone watching to see when the sun climbed between two buildings. That was how exact it got for most people. Asked what time it was back then, the best you could have answered — the best you needed to answer — would have been "after lunch."

So did 1:37 p.m. even exist a thousand years ago for peasants living in the Dark Ages of Europe, Song Dynasty China or the central Persian Empire? Was there such a thing as 1:37 p.m. across the millennia that comprise the vast bulk of human experience?

The short answer is "no."

But 1:37 exists for you. As a citizen of a technologically advanced culture, replete with omnipresent time-metering technologies, you have felt 1:37 in more ways then you probably want to think about. Waiting for a 1:30 train into the city you feel the minutes crawl by when the train is late. The same viscous experience of these minutes (and seconds) oozes into your life you each time you wait for the microwave to cycle through its 2-minute and 30-second cooking program.

You f*eel* minutes in a way that virtually none of your ancestors did. You feel them pass and you feel them drag on with all the frustration, boredom, anxiety and anger that can entail. For you, those minutes are real.

Measured against the long arc of human evolution, that experience is something new and utterly radical. In 2000 BCE or 850 CE there was no culturally agreed-upon 1:37 p.m. It simply did not exist and it could not have existed. We invented it and all of the time-behavior that goes with it. Then we used that time to imagine entire new ecosystems of human activity into existence.

There is no doubt that this new time we invented has brought us many benefits. If we start at the beginning, however, we can also see its darker, more dangerous side. If we track the bright line of its development through two centuries of science, technology and culture we can see this "modern" time pushing us all to the edge.

Once that vantage point is gained, this new version of time becomes obviously complicit in so much of our unbalancing: economies driven into dangerous waters; Earth's altered atmospheric chemistry; the manic consumption of our natural resources.

http://www.npr.org/blogs/13.7/2011/09/23/140718434/time-crisis-why-you-don-t-care-about-today-s-equinox

Bobby McFerrin's "Don't Worry, Be Happy": A Neuropsychology Reading

by Maria Popova

Unpacking the lyrics of the iconic happiness anthem to find surprising science-tested insights on well-being.

In 1988, Bobby McFerrin wrote one of the most beloved anthems to happiness of all time. On September 24 that year, **"Don't Worry Be Happy"** became the first a cappella song to reach #1 on the Billboard Top 100 Chart. But more than a mere feel-good tune, the iconic song is brimming with neuroscience and psychology insights on happiness that McFerrin — whose fascinating musings on music and the brain you might recall from World Science Festival's *Notes & Neurons* — embedded in its lyrics, whether consciously or not.

To celebrate the anniversary of "Don't Worry, Be Happy," I unpack the verses to explore the neuropsychology wisdom they contain in the context of several studies that offer lab-tested validation for McFerrin's intuitive insight.

In every life we have some trouble
When you worry you make it double

Our tendency to add more stress to our stress by dwelling on it is known is Buddhism as the second arrow and its eradication is a cornerstone of mindfulness practice. But now scientists are confirming that worrying about our worries is rather worrisome. Recent research has found prolonged negative cardiac effects of worry episodes, following a 2006 study that linked worrying to heart disease.

Here, I give you my phone number
When you worry call me
I make you happy

Multiple studies have confirmed the positive correlation between social support and well-being, and some have examined the "buffering model," which holds that social support protects people from the adverse effects of stressful events.

Harvard physician Nicholas Christakis has studied the surprising power of our social networks, finding profound and long-term correlation between the well-being, both physical and mental, of those with whom we choose to surround ourselves and our own.

Cause when you worry
Your face will frown
And that will bring everybody down

Mirror neurons are one of the most important and fascinating discoveries of modern neuroscience — neurons that fire not only when we perform a behavior, but also when we observe that behavior in others. In other words, neural circuitry that serves as social mimicry allowing the expressed emotions of others to trigger a reflection of these emotions in us. Frowns, it turns out, are indeed contagious.

Put a smile on your face

Pop-culture wisdom calls it "fake it 'till you make it"; psychotherapy calls it "cognitive behavioral therapy"; social psychology call it story editing. Evidence abounds that consciously changing our thoughts and behaviors to emulate the emotions we'd like to feel helps us internalize and embody those emotions in a genuine felt sense. Paul Ekman, who pioneered the study of facial expressions, found that voluntarily

producing a smile may help deliberately generate the psychological change that takes place during spontaneous positive affect — something corroborated in the recently explored science of smiles.

Don't worry, it will soon pass
Whatever it is

In 1983, UCLA psychologist Shelley E. Taylor published a seminal paper [PDF] in the journal *American Psychologist* proposing a theory of cognitive adaptation for how we adjust to threatening events, based on evidence from a number of clinical and empirical studies indicating that we grossly overestimate the negative impact of the events that befall us, from cancer to divorce to paralysis, and return to our previous levels of happiness shortly after these negative events take place.

As Daniel Gilbert puts it in *Stumbling on Happiness*, one of our 7 must-read books on the art and science of happiness, "The fact is that negative events do affect us, but they generally don't affect us as much or for as long as we expect them to."

* * *

So there you have it: **"Don't Worry, Be Happy,"** timeless oracle of mental health science. For more on the profound and fascinating intersection of music and mind, see our omnibus of 7 essential books on music, emotion, and the brain.

http://www.brainpickings.org/index.php/2011/09/23/bobby-mcferrin-dont-worry-be-happy-neuroscience-psychology/

Why you are identifiable after just a few steps

- 14:59 15 September 2011 by **Lisa Grossman**

Airport security may soon have a new way to check your ID: watching the way you walk. It seems footsteps are as unique as fingerprints, and can identify people with 99.8 per cent accuracy.

"For the first time, our results show that it probably is possible to use this in a real-world security application," says Todd Pataky of Shinshu University in Nagano, Japan.

Earlier studies suggested that everyone walks in a unique way that can be captured on film or by pressure sensors. But these studies tended to look at only 10 people each, making it difficult to tell how well the methods would work in the real world.

So Pataky and colleagues asked 104 people to walk across a half-metre-long board studded with thousands of pressure sensors, recording ten steps per person. The sensors recorded how each foot applied pressure to the ground, and how that pressure distribution changed as the person walked.

Patterned footsteps

The information collected was then input into a computer and used to train an algorithm to pick out the patterns in people's steps. Of the 1040 steps recorded, the algorithm wrongly identified only three – a 99.8 per cent success rate.

"Even if they have the same foot size, even if they have the same shape, [people] load their feet differently, and they do it consistently," Pataky says. Similar sensors, which are available commercially for about $20,000, could be used in airports to identify passengers as they walk barefoot through security.

Christopher Nester of the University of Salford in the UK thinks the technique could be used as a diagnostic tool for foot diseases and orthotics. As for security applications, he sees another, perhaps overlooked, drawback. "Nobody minds putting their fingertip on a glass surface, which is clean," he says. "But we very rarely wash our feet."

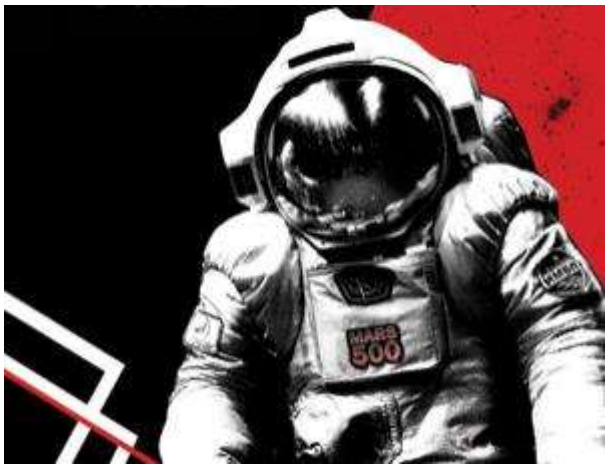
Journal reference: *Journal of the Royal Society Interface*, DOI: 10.1098/rsif.2011.0430

http://www.newscientist.com/article/dn20919-why-you-are-identifiable-after-just-a-few-steps.html?full=true&print=true

520 days: Surviving everyday life on a mission to Mars

- 23 September 2011 by **Anne-Marie Corley**

Magazine issue 2830.



Getting to Mars is all in the mind

One of the most extreme psychological experiments ever is drawing to a close. ***New Scientist*** *gets exclusive access to Mars 500's mission control*

CHIEF engineer Konstantin Chetvergov strides into the ground control room, work boots clicking on the brown-speckled floor. The buzz of conversation halts, leaving only the sound of whirring electronics and the engineer's march. It is day 334 of a 520-day mission to Mars and Chetvergov's team has a problem.

He sits down in front of five monitors displaying life-support schematics. A warning light is flashing, telling him something is amiss with the shower cabin on the Mars crew's spacecraft. It's a worry. Small things can escalate when six astronauts are cooped up together for a year and a half.

The engineer leans forward and speaks into a camera and microphone. "Good afternoon, crew," he says. "This message is to request a check of the shower-drainage system at about" – he glances up at the clock and calculates – "6 o'clock." He adds a few more words, then signs off. For now, that's all ground control can do. The recorded message disappears into the void, starting a 9-minute journey to the crew. Chetvergov turns to us. We have a while to wait.

Chetvergov is a participant in one of the most extreme and ambitious scientific experiments ever staged: Mars 500. It is the most realistic simulation of a mission to the Red Planet yet: six male "Marsonauts" from Russia, Europe and China have been shut off from the world for more than a year in a mock spacecraft here on Earth. In June 2010, they climbed into a set of modules at the Russian Academy of Science's Institute for Biomedical Problems (IMBP), in Moscow, and they are still inside as you read this.

It's for a good reason: if we send people to Mars, it will be the longest human space flight ever attempted. In the unimaginably claustrophobic spacecraft, the psychological stresses will be enormous, so it's vital that we know what happens to the human mind in such conditions. Discontent, arguments and misunderstandings have dogged shorter space missions and isolation experiments in the past (see "When no one can hear you scream").

So, as Mars 500 draws to a close, what have we learned? Many results will not be released until after the Marsonauts emerge, roughly 50 days from now, but *New Scientist* got exclusive access to the ground-control team interacting daily with the crew. These engineers, psychologists and doctors are as much a part of the mission as the isolated men. With great power to influence the lives of the Marsonauts, Chetvergov and his team have been trying to find out what it takes to keep their charges healthy and contented. Getting to the Red Planet will be one of the human race's greatest scientific and technical challenges, but a more fundamental question is: are we ready to put humans inside the spacecraft?

I am visiting the Mars 500 experiment three months after its midpoint, which featured a simulated Mars landing. The crew is now on its return journey to Earth. The approach to the control room takes me past bronze busts of Russia's space giants – Konstantin Tsiolkovsky, Sergei Korolev, Yuri Gagarin – and up the stairs to a catwalk, which overlooks the "spacecraft": a set of interconnected cylindrical modules. The windowless chambers are locked and soundproofed, with air and water piped in. The six volunteers inside eat only what they brought and what they can grow. They jettison their garbage via an airlock, along with flash drives and memory cards containing the results of myriad experiments. These appear daily for technicians to collect and sort. Nothing goes back in.

The experiment's control centre, on the second floor of the complex, is continuously occupied by a three-person brigade on shifts lasting 24 hours. Opposite a larger-than-life poster of a grinning Gagarin, huge flat-screen monitors display every camera angle of the inside of the modules, revealing exercise machines, a kitchen, research workstations and a "greenhouse". On the control room's windowsill is a bright red flower on a tall stalk that was tended inside the spacecraft during the pilot study. Beyond it, traffic creeps along: standard for urban Moscow.

Forty minutes after Chetvergov sent his message to the Mars 500 crew, an electronic telephone ring interrupts our conversation. A message from Mars! Well, not quite. Chetvergov pulls up the video recording of the crew commander's response: the button they press to drain the shower cabin is not responding, he reports. Chetvergov furrows his brow, closes the message, and exchanges a few words with Vladimir Gorbachev, the tall, silver-goateed duty engineer. Gorbachev grabs a radio and a flashlight. Together, they head out of the door to investigate.

Although the ground control team is around to monitor the crew's vital signs, help solve technical problems and change air canisters, on a real interplanetary mission the crew would have to fend for itself. So, unlike in real-world control rooms for shorter missions, the Mars 500 duty team members rarely interact with the crew. When they do, they certainly don't give orders. They "request".

Experience on Earth-orbiting space stations suggests that long-duration space crews do not react well to being "commanded" by ground control, says IMBP psychologist Vadim Gushin, who is conducting research on the Mars 500 crew. International Space Station astronauts are currently given two days off a week; they have a "task jar" from which they can choose experiments or chores if they wish, but they are not required to do so.

Studies from space-flight simulations such as the Mars 105 mission – a three-month Mars 500 pilot study carried out in 2008 – and NASA's underwater Extreme Environment Mission Operations (NEEMO) programme, have similarly found that minimal interference from ground control can be a good thing, putting the crew in a better mood while still accomplishing the mission.

Plus, when travelling beyond Earth orbit, real-time chats with mission control will be impossible, so crews will have to learn to deal with problems and procedures themselves.

During one of the "Mars walks" in February, for example, one Mars 500 crew member asked a question of ground control as he attempted a complicated task – but of course didn't get an immediate answer due to the communications delay. He then seemed to lose motivation, say the psychologists.

Silent running

Accordingly, Mars 500 researchers later tested the crew's ability to go it alone. During a week of simulated communication failure between ground control and the Mars crew, duty doctor Dilia Husnutdinova tells me that the crew coped with their tasks just fine. "Sometimes they made posters and held them up to the cameras" to highlight technical problems, she says. But with no threat to life or the mission, controllers decided to keep silent. "We ignored them because it wasn't a big deal."

Even on a normal day, two 2-hour windows of communication between crew and ground control are all they have to exchange official messages like engineering needs, research schedules or personal communication with family. That's stricter than for astronauts and cosmonauts on the ISS, who can call home at any time – often talking to family members twice a day. Mars 500 messages are dropped onto a local server and picked up by the crew after the appropriate time delay – anywhere from a few minutes to 12, depending on the ship's "orbit" and distance from Earth.

This is the first time an experiment has had such strict contact limits for so long, psychologist Gushin says. In the IMBP simulations that came before Mars 500 and its pilot study, test subjects and researchers peeked through airlocks at one another, waved and exchanged greetings. On a real mission to Mars, psychologists say, the harsh reality will be limited communication and sensory deprivation, and the experiment should reflect that isolation.

According to Gushin, people do eventually adapt to such deprivation. "The need for this interaction actually falls off," he says. During IMBP space-flight simulations in 1994 and 1995, for example, correspondence with mission control decreased as the experiment wore on. A study of the Mars 105 crew found that, similarly, the Marsonauts communicated intensively with ground control at first, but after adapting to their isolation, they wrote shorter, less emotional reports with fewer requests for help to solve problems related to their work.

Constant contact with family and friends can also heighten stress. "Every extra word, extra worry, can become an irritant," Gushin says. Likewise, a burst of communication after not very much of it can be unhelpful. "It's like a person who has been hungry a long time allowed to eat at a big table full of food," Gushin says. "It will be bad for him."

Olga Shevchenko, who leads the psychological support for the Mars 500 crew, agrees. She makes no bones about her responsibility. It's not to coddle the crew, but to balance their psychological health with the needs of the mission. "Our job is most importantly to ensure that the experiment doesn't stop," she says. That means making sure they are not worried about solving problems at home, or asking to leave early – which they are allowed to do at any time.

Shevchenko is in her mid-50s, with a neat crop of dark hair, glasses, and a sharp, ready laugh. We are in her high-ceilinged office on the third floor. A vase of birthday flowers adorns a small side table, but the room is almost bare. A pack of cigarettes and an ashtray sit on her desk. From here, tucked away from the whirring of the control room below, Shevchenko directs the flow of information to and from the Marsonauts locked inside their craft. She has taken no vacation during the term of the experiment.

A "trusted face" for the crew's concerns, questions, and needs, Shevchenko interacts with the crew almost daily via time-delayed emails and videos. She is their link to news, books and video games, and life on the outside. She also works with the crew's families and friends to ensure that information that gets to the test subjects is good for them, and for the experiment.

It's a daunting task. She collects and sends news summaries from TV and newspapers three times a week to the local server, adding interesting programmes about science, cars, and sports events when they ask. She

sends each crew member's personal mail over a private channel every day. While she cannot read that mail, she can see the results of bad news. If she sees a crew member becoming irritated, Shevchenko talks to the family to coach them on presenting information.

In more than 15 years of working at the IMBP on isolation and psychological experiments, as well as supporting cosmonauts on the Mir space station and ISS, Shevchenko has learned what kind of information is desirable, what needs to be couched carefully and what is better left unsaid. For example, she avoids sending information about criminal activity in the news. It's upsetting, she says, and there's nothing the crew can do about it.

Likewise, world events such as bombings or plane crashes must be handled delicately, she says. During Mars 105, for example, two French Airbus planes crashed. One of the crew was an Airbus instructor pilot, so before breaking that news, the psychologists tried to find out if he knew any of the victims. And when a bomb exploded in Moscow's Domodedovo Airport this January, Shevchenko held that news until she had contacted the families of the Russian crew members, ensuring that none of their friends or loved ones were hurt or killed. In the meantime, however, the Russians heard about the event from their European crew mates, who had already got the news from their private messages, and demanded to know why they hadn't been told.

Tough love

Shevchenko is adamant that she made the best choice. "We don't have the right to give that as some sensational fact," she says, raising her voice and lighting a cigarette. She explains that the precedent was set in the early days of Soviet space flight, when cosmonaut Georgy Grechko's father died while he was in space in 1978. Back then it was forbidden to give him that information, for fear it would adversely impact Grechko's mission. He was told of the death only after his return to Earth.

These days, however, news about problems back home is disseminated, but carefully. In every instance of potential stress for the crew, be it their sick child or an earthquake near their family, Shevchenko gathers as much information as possible, asking relations and friends for input about how the person might react to certain information. "Everything depends on the individual," she says.

She blows smoke toward the ceiling and leans forward. "Because we all understand," she says. "Sitting in there, they all worry. But the worry multiplies, because you can't do anything. You are powerless."

Back in the control room, evening is approaching and duty engineer Gorbachev is preparing for the long night ahead. His shift won't end until 10am tomorrow, but he's in high spirits. They have solved the mystery of the shower drain: it turns out the crew cut three people's hair in the past two weeks, so when they went to take showers, they clogged up the drain. "It's banal, everyday stuff," Gorbachev says, "but all the same we learn something. The small, routine things – they're all part of the experiment." So far, say IMBP researchers, the Mars 500 crew seem to be doing fine, with no major interpersonal conflicts, and physical and psychological strength close to baseline levels.

That's already a big result, says Gorbachev, glancing at the wall monitors, as he always does when he talks about the crew. "Look!" Two of them are talking in the kitchen, munching on fresh strawberries. "If they're still in there, still smiling and talking, still sitting together," he says, "then all is well."

Achieving harmony is no mean feat, psychologist Gushin points out. So far the crew has shown it can live and work in this environment. "That doesn't mean it's good, doesn't mean it's easy, and it doesn't mean everything will be easy from here on," he says.

To get to Mars, we will need to find suitable spacecraft, radiation shields and engines. But alongside this enormous challenge is the human one – dealing with monotony, arguments, or even a clogged shower. Happily, the lesson from Mars 500 is that we now know enough to support the isolated Marsonauts on their trip. In other words, Shevchenko says: "It means we're ready."

When no one can hear you scream

On the whole, space crews get along fine, but in a few cases it was all too much...

• In 1973, the crew members of NASA's experimental space station programme, Skylab, "rebelled" against mission control. All first-time astronauts, they felt stressed under the heavy workload enforced by ground control and turned off their radios for a day, refusing to talk. It worked: their workload was reduced, and they completed the mission successfully.

• During a record-length mission in 1982, two Russian cosmonauts got on each other's nerves so much that they allegedly refused to speak to each other for the majority of their 211-day flight on the Salyut space station.

• Tensions rose during a 1999 study called "Simulation of Flight of International Crew on Space Station" (SFNCSS). Held at the same complex as Mars 500 in Moscow, one aim was to study how crews from different nations mixed. Not smoothly, it turned out. Canadian volunteer Judith Lapierre claimed that she had been kissed against her will by a Russian crew member at the New Year party. The incident resulted in the four Russians being locked out from the living quarters of the others. Lapierre remained to complete the experiment, but a Japanese participant chose to leave early.

Anne-Marie Corley *is a writer based in Dallas, Texas*

http://www.newscientist.com/article/mg21128301.700-520-days-surviving-everyday-life-on-a-mission-to-mars.html

Second big satellite set to resist re-entry burn-up

- 08:00 23 September 2011 by **Paul Marks**

Incoming! *(Image: Max Planck Institute for Extraterrestrial Physics)*

Even if NASA's 6-tonne UARS satellite does not cause any injury or damage when it re-enters the Earth's atmosphere today, there is more space junk headed our way next month. A defunct German space telescope called ROSAT is set to hit the planet at the end of October – and it even is more likely than UARS to cause injury or damage in populated areas.

No one yet knows where UARS (Upper Atmosphere Research Satellite) will fall to earth. Although most of the craft's mass will be reduced to an incandescent plasma, some 532 kilograms of it in 26 pieces are forecast to survive – including a 150-kilogram instrument mounting.

NASA calculates a 1-in-3200 chance of UARS causing injury or damage. But at the end of October or beginning of November, ROSAT – a 2.4-tonne X-ray telescope built by the German aerospace lab DLR and launched by NASA in 1990 – will re-enter the atmosphere, presenting a 1 in 2000 chance of injury.

The higher risk stems from the requirements of imaging X-rays in space, says DLR spokesperson Andreas Schütz. The spacecraft's mirrors had to be heavily shielded from heat that could have wrecked its X-ray sensing operations during its eight-year working life. But this means those mirrors will be far more likely to survive a fiery re-entry.

Broken mirror, bad luck

On its ROSAT website, DLR estimates that "up to 30 individual debris items with a total mass of up to 1.6 tonnes might reach the surface of the Earth. The X-ray optical system, with its mirrors and a mechanical support structure made of carbon-fibre reinforced composite – or at least a part of it – could be the heaviest single component to reach the ground."

At the European Space Agency in Darmstadt, Germany, the head of the space debris office, Heiner Klinkrad, agrees that ROSAT's design means more of it will hit the surface. "This is indeed because ROSAT has a large mirror structure that survives high re-entry temperatures," he says.

ROSAT was deactivated in 1999 and its orbit has been decaying since then. "ROSAT does not have a propulsion system on board which can be used to manoeuvre the satellite to allow a controlled re-entry," says space industry lawyer Joanne Wheeler of London-based legal practice CMS Cameron McKenna. "And the time and position of ROSAT's re-entry cannot be predicted with any precision due to fluctuations in solar activity, which affect atmospheric drag."

Solar swelling

US Strategic Command tracks all space objects and the US-government-run Aerospace Corporation lists both upcoming and recent re-entries on its website. But ROSAT is not yet on the upcoming list because its re-entry time is far from certain.

The moment a craft will re-enter is difficult to predict because it is determined by two main factors. First, the geometry of the tumbling satellite as it enters the upper atmosphere, which acts as a brake. Second, the behaviour of the upper atmosphere itself, which grows and shrinks with the amount of solar activity, says Hugh Lewis, a space debris specialist at the University of Southampton, UK.

"Solar activity causes the atmosphere to expand upwards, causing more braking on space objects. The reason UARS is coming back sooner than expected is a sudden increase in solar activity. Indeed, we expect to see a higher rate of re-entries as we approach the solar maximum in 2013," he says.

But don't expect it to be raining spaceships – what's coming down is partly a legacy of 1990s space-flight activity. "Some of the re-entries we see today [with UARS and ROSAT] are a heritage of years with high launch rates, which were a factor of two higher than they are today," says Klinkrad.

"The trend is towards smaller satellites, with more dedicated payloads," he says, rather than "all-in-one" satellite missions on giant craft like UARS. That means debris from future missions should be smaller.

http://www.newscientist.com/article/dn20955-second-big-satellite-set-to-resist-reentry-burnup.html?full=true&print=true

Will the universe end in a big snap?

- 22 September 2011 by **David Shiga**

Magazine issue 2831.

Will space-time blow apart? (Image: Ashley Cooper/Visual Unlimited/Getty)

Focusing on a logical but gruesome end for the universe could reveal elusive quantum gravity

IMAGINE one day you wake up and look at yourself in the mirror only to find that something is terribly wrong. You look grainy and indistinct, like a low-quality image blown up so much that the features are barely recognisable. You scream, and the sound that comes out is distorted too, like hearing it over a bad phone line. Then everything goes blank.

Welcome to the big snap, a new and terrifying way for the universe to end that seems logically difficult to avoid.

Dreamed up by Massachusetts Institute of Technology cosmologist Max Tegmark, the snap is what happens when the universe's rapid expansion is combined with the insistence of quantum mechanics that the amount of information in the cosmos be conserved. Things start to break down, like a computer that has run out of memory.

It is cold comfort that you would not survive long enough to watch this in the mirror, as the atoms that make up your body would long since have fallen apart. But take heart, accepting this fate would without question mean discarding cherished notions, such as the universe's exponential "inflation" shortly after the big bang. And that is almost as unpalatable to cosmologists as the snap itself.

So rather than serving as a gruesome death knell, Tegmark prefers to think of the big snap as a useful focal point for future work, in particular the much coveted theory of quantum gravity, which would unite quantum mechanics with general relativity. "In the past when we have faced daunting challenges it's also proven very useful," he says. "That's how I feel about the big snap. It's a thorn in our side, and I hope that by studying it more it will turn out to give us some valuable clues in our quest to understand the nature of space." That would be fitting as Tegmark did not set out to predict a gut-wrenching way for the universe to end. Rather, he was led to this possibility by some puzzling properties of the universe as we know it.

According to quantum mechanics, every particle and force field in the universe is associated with a wave, which tells us everything there is to know about that particle or that field. We can predict what the waves will look like at any time in the future from their current state. And if we record what all the waves in the universe look like at any given moment, then we have all the information necessary to describe the entire universe. Tegmark decided to think about what happens to that information as the universe expands (arxiv.org/abs/1108.3080).

To understand his reasoning, it's important to grasp that even empty space has information associated with it. That's because general relativity tells us that the fabric of space-time can be warped, and it takes a certain amount of information to specify whether and in what way a particular patch of space is bent.

One way to visualise this is to think of the universe as divided up into cells 1 Planck length across - the smallest scale that is meaningful, like a single pixel in an image. Some physicists think that one bit of information is needed to describe the state of each cell, though the exact amount is debated. Trouble arises, however, when you extrapolate the fate of these cells out to a billion years hence, when the universe will have grown larger.

One option is to accept that the added volume of space, and all the Planck-length cells within it, brings new information with it, sufficient to describe whether and how it is warped. But this brings you slap bang up against a key principle of quantum mechanics known as unitarity - that the amount of information in a system always stays the same.

What's more, the ability to make predictions breaks down - the very existence of extra information means we could not have anticipated it from what we already knew.

Another option is to leave quantum mechanics intact, and assume the new volume of space brings no new information with it. Then we need to describe a larger volume of space using the same number of bits. So if the volume doubles, the only option is to describe a cubic centimetre of space with only half the number of bits we had before (see diagram).

This would be appropriate if each cell grows, says Tegmark. Where nothing previously varied on scales smaller than 1 Planck length, now nothing varies on scales smaller than 2 Planck lengths, or 3, or more depending how much the universe expands. Eventually, this would impinge on the laws of physics in a way that we can observe.

Photons of different energies only travel at the same speed under the assumption that space is continuous. If the space-time cells became large enough, we might start to notice photons with a very short wavelength moving more slowly than longer wavelength ones. And if the cells got even larger, the consequences would be dire. The trajectories of waves associated with particles of matter would be skewed. This would change the energy associated with different arrangements of particles in atomic nuclei. Some normally stable nuclei would fall apart.

Chemical reactions would get messed up too, since these depend critically on the energy associated with configurations of electrons and ions that would be altered by the large granularity of space. Living things would regrettably cease to function. "It would probably kill us at the point where the nuclear physics gets messed up," Tegmark says. "Many of the atoms of which we're made would disintegrate."

Does a gruesome future await? Maybe not. If the big snap is really what's in store, we should already be seeing signs of it - and thankfully we are not.

In an expanding universe with a finite lifetime, most of the volume - along with its stars, galaxies, and planets - shows up for the final curtain, simply because that is when the universe has grown to its largest size. If we assume the early universe expanded at an extremely rapid pace, as posited by the widely accepted theory of inflation, we are most likely to be just a few billion years away from the big snap. In that case, the granularity of space should already be large enough to skew the arrival time of photons of different wavelengths in gamma-ray bursts. Yet observed gamma-ray bursts, powerful stellar explosions that can be seen from extremely far off, show no sign of such an effect.

Therefore, for the universe to end in a big snap, we either have to reject inflation altogether. Or alternatively assume we are very atypical beings, and do in fact occupy a special place in the universe in violation of the Copernican principle. Both options are anathema to cosmology. "There's something here that's just very wrong," Tegmark says.

Raphael Bousso of the University of California in Berkeley and Andreas Albrecht of UC Davis, both agree. A big snap in the universe's future "somehow can't be right", says Bousso.

That's a relief. But what does happen to information in an expanding universe, then? Tegmark hopes that a complete theory of quantum gravity, which would describe how the tiniest regions of space and their associated information behave, might change the whole picture in a way that avoids the big snap.

"A lot of people in quantum gravity have gotten a little depressed," he says. There is a sense that progress cannot be made without building particle accelerators to probe space down to the Planck length, which is so far beyond today's technology that it seems out of the question.

Pondering the big snap, however, could stimulate new ways of thinking. Tegmark says: "I suspect there might be other ways of learning about quantum gravity without building impossible machines."

http://www.newscientist.com/article/mg21128314.200-will-the-universe-end-in-a-big-snap.html?full=true&print=true

Missing planet explains solar system's structure

- 15:45 22 September 2011 by **Lisa Grossman**

The solar system once had five giant gaseous planets rather than the four it has today. That's the conclusion from a computer simulation of the solar system's evolution, which suggests the fifth giant was hurled into interstellar space some 4 billion years ago, after a violent encounter with Jupiter.

Astronomers have struggled for decades to explain the solar system's current structure. In particular, Uranus and Neptune couldn't have formed where they are today – the disc of gas that congealed into the planets would have been too thin at the edge of the solar system to account for the ice giants' bulk.

A more likely scenario is that the planets were packed close together when they formed, and only spread out when the disc of gas and dust from which they formed was used up. The tighter orbits of extrasolar planet systems support this idea.

But the great gravitational bullies of the solar system, Jupiter, Saturn, Uranus and Neptune, would not have gone quietly to their new homes. Previous simulations show that at least one planet, usually Uranus or Neptune, should have been ejected from the solar system in the shuffle.

"People didn't know how to resolve that," says David Nesvorny of the Southwest Research Institute in Boulder, Colorado.

Now Nesvorny proposes a solution: a sacrificial ice giant between Saturn and Uranus that takes the fall for its planetary siblings.

Five planets to four

"If you start with five gaseous planets, then you see again that you lose one planet," he says. "In a large fraction of cases, you end up with a good solar system analogue."

Nesvorny ran a total of 6000 computer simulations with four or five gas giants in various initial positions around the sun. His simulated runs started shortly after the gas disc dissipated and lasted for 100 million years, long enough for the planets to settle into their final orbits.

All but 10 per cent of the four-planet simulations wound up with only three left, he says. But in half the five-planet simulations, they ended with the four in a solar system that looks remarkably like our own. The best results occurred when the fifth planet started off between Saturn and Uranus and ended up being ejected after an encounter with Jupiter. His work has been accepted for publication in *Astrophysical Journal Letters*.

The five-planet scenario solves a few other mysteries as well. For the inner rocky planets to survive intact while the outer gas giants jockeyed for position, some previous simulations show that Jupiter must have "jumped" from a position closer to the sun to its current orbit.

"This jumping Jupiter theory is very difficult to achieve for the four-planet system. But it's a natural consequence of the five-planet system," Nesvorny says. If Jupiter flung the lost ice giant from the solar system, it would have lost angular momentum and receded from the sun. "That comes for free from the set-up."

The reshuffling could also have disturbed the still-forming Kuiper belt and Oort cloud – reservoirs of proto-planets that lie beyond the current orbit of Neptune – flinging debris toward the inner solar system. That could explain the period of violence thought to have occurred 4 billion years ago, when the moon gained most of its craters. This is the period astronomers call the "late heavy bombardment".

Lone wolf

The long lost planet may still be out there. In May, astronomers in Japan announced that they had spotted lonely planets wandering through the dark space between stars. These lone wolfs may be even more common than star-bound worlds, the team reported. If the fifth gas giant is still out there, it will be one of the wandering exoplanets.

Today's planets may have had other siblings as well. Previous researchers have suggested that a fifth rocky planet may have been ejected from an orbit between Mars and Jupiter, and that super-Earths may have been swallowed by Jupiter or Neptune.

"Our solar system looks calm and quiet now, but we pretty much know that it had this violent past," Nesvorny says. "The question is, how violent was it?"

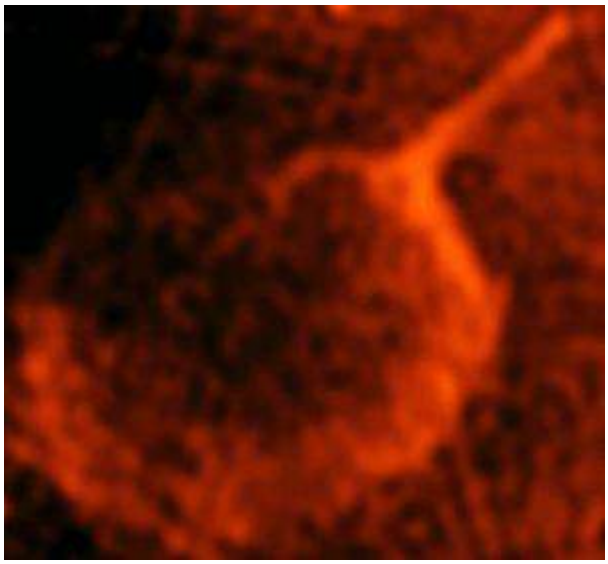
Nesvorny has had several suggestions from colleagues for a name for the new planet. These include Hades, the unseen god of the underworld from Greek mythology, and "Thing 1" from Dr Seuss's book *The Cat in the Hat*. The latter leaves open the possibility for a "Thing 2" if future work shows the need for more than one planet. But he is not yet persuaded. "I'm not sure I like any of them," he admits.

Reference: arxiv.org/abs/1109.2949

http://www.newscientist.com/article/dn20952-missing-planet-explains-solar-systems-structure.html?full=true&print=true

Frying pan forms map of dead star's past

- 15:03 22 September 2011 by **David Shiga**



Out of the fire, into the frying pan *(Image: University of Sydney)*

Astrophile *is our weekly column covering curious cosmic objects, from within the solar system to the furthest reaches of the multiverse*

Object type: Supernova remnant
Distance: 26,000 light years

Ten millennia ago, when humanity was busy inventing agriculture, a bright new star in the constellation we know as Centaurus may have awed our ancestors. After exploding as a supernova, the star would have faded from view within a year or so – and eventually from living memory, until, 25 years ago, a radio telescope near Canberra, Australia, found its curious remains.

And what remains they are. Remnants of supernovae tend to be seen as roundish clouds expanding symmetrically from the original explosion site, but the Centaurus remnant is shaped like a frying pan.

Fresh calculations confirm that this unique shape is not just a curiosity: it is a map of the supernova's entire history, which includes one of the fastest-moving stars in the galaxy.

Back in 1986, the original discovery team – led by Michael Kesteven, then of the Herzberg Institute of Astrophysics in Victoria, British Columbia, Canada – noted the odd shape of the remnant.

Cosmic lighthouse

In addition to the usual vaguely round shell of hot, expanding gas, this one had something long and narrow sticking out of it. Was this some sort of jet shot out from the dying star, the team wondered?

There was little further progress until 2009, when another team found an important new clue to the shape of this peculiar object, which they nicknamed the frying pan. Led by Fernando Camilo of Columbia University in New York, they had another look at the object with another Australian telescope: the Parkes Observatory radio telescope in New South Wales.

At the end of the frying pan's handle they discovered a neutron star – the crushed core of the star that had died in the supernova. This neutron star is spinning fast and, like a cosmic lighthouse, gives off radio beams that sweep around as the star rotates, appearing to us as regular pulses. Such pulsing neutron stars are appropriately called pulsars.

The team concluded that the supernova explosion hurled this stellar corpse from the blast site, leaving behind a glowing trail, which is still seen today as the handle of the frying pan.

Entire history

Now new radio measurements and calculations by a team led by Stephen Ng of McGill University in Montreal, Canada, confirm this picture.

The pulsar is unlikely to be an interloper that just happened to pass through the supernova remnant – the odds of that are about 800 to 1, given that the remnant is relatively small and pulsars are few and far between, the team says.

Other glowing pulsar trails have been found, but this is the first that is connected all the way back to its supernova remnant. That makes it a record of the supernova's entire history, from the explosion right up to the dead core's current position.

"Most pulsar tails are too old – the supernova remnant has already dissipated," says Ng.

Asymmetrical mystery

The pulsar is thought to have left the glowing trail because of the wind of energetic particles that it spews into the surrounding space. This wind ploughs into galaxy's interstellar gas, energising it and making it glow.

Based on the width of the trail, Ng's team estimates the pulsar's speed at between 1000 and 2000 kilometres per second. That could make it the fastest star known: the current record-holder is another neutron star, racing at 1500 kilometres per second from the Puppis A supernova remnant where it was born.

Such speeding neutron stars are a puzzle, because supernova explosions should be pretty symmetrical, making it unlikely that they would provide a strong kick in any one direction. Solving the puzzle of the frying pan's origin may have deepened another one.

Reference: arxiv.org/abs/1109.2233

Read previous Astrophile columns: The most surreal sunset in the universe, Saturn-lookalike galaxy has a murky past, The impossibly modern star, The diamond as big as a planet

http://www.newscientist.com/article/dn20951-astrophile-frying-pan-forms-map-of-dead-stars-past.html?full=true&print=true

New doubts about 'poster child' of exoplanets

- 17:06 21 September 2011 by **Lisa Grossman**

When it comes to alien worlds, even poster children are fickle. Fomalhaut b – one of the first and only exoplanets to be photographed directly – may not be what it seems.

Astronomers expected to find a planet orbiting the young, nearby star Fomalhaut since 2005, when Hubble Space Telescope images showed that the star's spectacular dust disc lies a bit off-centre.

Sure enough, in 2008, Paul Kalas of the University of California, Berkeley, and colleagues spotted a wandering speck of light in two separate images taken by the Hubble Space Telescope's Advanced Camera for Surveys in 2004 and 2006.

These were combined to form the image shown (right), which contains two positions for the planet. Fomalhaut b became known as one of the only directly imaged exoplanets.

Disc disruption?

The candidate planet lies about 120 times as far from its star as the Earth lies from the sun, and apparently nestles neatly into a gap in the dust disc. Astronomers suggested that the planet's gravity created an opening in the disc at that spot, the same way that some of Saturn's moons open gaps in its rings.

The trouble is, in the three years since the 2008 discovery, no other telescope had detected the planet.

The Hubble instrument used to take the first images broke in 2007, and will not be repaired. So Kalas and colleagues used an older Hubble camera to take another peek in 2010. As they reported on 12 September, at the Extreme Solar Systems II conference in Moran, Wyoming, this revealed the bright speck again.

This time, however, it was in an unexpected place. "That's a problem," says Steinn Sigurdsson of Pennsylvania State University in University Park, who helped organise the conference. To make sense of it, the planet would need an elliptical orbit that takes it across the dust disc, yet its brightness suggests that it is too big to do so without disrupting the disc.

Hidden planet

That's causing Ray Jayawardhana of the University of Toronto, Canada, to doubt whether the initial images really were of an exoplanet. Jayawardhana was not involved in the planet's discovery but he gave a talk at the same meeting about the problems with imaging exoplanets. "I would say the evidence is confusing and contradictory at best," he says.

Kalas is not giving up. Possible explanations include a second, hidden planet that holds the ring steady and perturbs Fomalhaut b's orbit.

Or it may be that the speck in the newest image is not a planet at all, but a transient dust cloud within the disc, a background star, or a tiny protostar that failed to ignite.

"It will all be solved with observations, probably within the next year," says Kalas. His team is scheduled to observe the Fomalhaut system with Hubble again in 2012.

Data squeeze

The controversy highlights the problems in claiming first dibs on exoplanet discoveries.

"There's a little bit of tension about priorities; who did what first. Things are happening so rapidly that discoveries are overlapping, and sometimes people are trying to get in the door before it slams," Sigurdsson says. "We're squeezing the data till it bleeds. Some of it's going to be wrong, no question."

That concerns Jayawardhana. "I feel a little bit uncomfortable that the poster boy for directly imaged planets is the weakest case or least secure case that we have," he says.

It's not the first exoplanet discovery to be potentially fickle. Just two weeks after the first life-friendly exoplanet was discovered – Gliese 581g – its existence was called into question by members of another team, who didn't see the planet in their data. Gliese 581g's existence still awaits confirmation.

http://www.newscientist.com/article/dn20945-new-doubts-about-poster-child-of-exoplanets.html

Engineers can build a low-carbon world if we let them

- 13:32 26 September 2011 by **Colin Brown**

The engineering solutions to combat climate change already exist. Politicians must be brave enough to use them before it's too late

One word sums up the attitude of engineers towards climate change: frustration. Political inertia following the high-profile failure of 2009's Copenhagen climate conference has coupled with a chorus of criticism from a vocal minority of climate-change sceptics. Add the current economic challenges and the picture looks bleak. Our planet is warming and we are doing woefully little to prevent it getting worse.

Engineers know there is so much more that we could do. While the world's politicians have been locked in predominantly fruitless talks, engineers have been developing the technologies we need to bring down emissions and help create a more stable future.

Wind, wave and solar power, zero-emissions transport, low-carbon buildings and energy-efficiency technologies have all been shown feasible. To be rolled out on a global scale, they are just waiting for the political will. Various models, such as the European Climate Foundation's Roadmap 2050, show that implementing these existing technologies would bring about an 85 per cent drop in carbon emissions by 2050. The idea that we need silver-bullet technologies to be developed before the green technology revolution can happen is a myth. The revolution is waiting to begin.

Climate call

The barriers preventing the creation of a low-carbon society are not technological but political and financial. That's why at a landmark London conference convened by the UK's Institution of Mechanical Engineers, 11 national engineering institutions representing 1.2 million engineers from across the globe, under the banner of the Future Climate project, made a joint call for action at December's COP17 climate change conference in Durban, South Africa.

The statement calls on governments to move from warm words to solid actions. They need to introduce legislation and financial support to get these technologies out of the workshop and into our homes and businesses and onto our roads. Targeted regulation and taxation will also drive innovation. This will require bold politics, and spending at a time when money is scarce. It is far from unaffordable, however. The UK's Committee on Climate Change, which advises the British government, continues to support the view of the Stern report – an assessment of the climate change challenge in the UK – that the move to a low-carbon society will cost no more than 1 per cent of GDP by 2050.

Resistance to wind turbines and the power lines they feed, nuclear power and electric cars, as well as the economic costs, all make public opinion a powerful brake on change. However the alternative seems certain to be worse. It is not only the challenges of a deteriorating climate: with inaction comes a great risk to our economy in the long term. The green technology revolution, just like the industrial revolution before it, will give jobs to those countries which have created the right conditions for it to flourish.

China in front

Which countries these will be is still an open question. India, Germany, Australia and the UK were among the nations signed up to the Future Climate statement, whereas the world's largest greenhouse gas emitters – China and the US – were not. When it comes to investment in clean technology, however, that's not the whole story.

Although China is continuing to build coal-fired electricity plants at an alarming rate to power its rapid economic growth, the UN Environment Programme confirmed last month that it is now by far the world's biggest investor in renewable energy. Last year, China's wind, solar and biomass power industries received $49 billion of new investment, a third of the global total, and it now has the largest installed wind capacity in the world. When predicting who the front runner in this next great technological revolution will be, it is difficult to see past the emerging superpower to the east.

The US is going in the opposite direction. A natural gas rush driven by the development of controversial "fracking" techniques over the past decade has echoes of the oil rush that transformed Texas a century ago. The *Financial Times* reports that just one company, BHP Billiton, is investing as much as $79 billion in US shale gas fields – over three times the amount invested in all US renewables in a year. This will secure cheap energy in the short term, but it is a finite resource and ultimately a dead end. In due course we could face the interesting prospect of the US turning to China to acquire its wind turbine technology.

Nuclear elephant

Investment in renewable energy is vital for a prosperous, low-carbon society. However, decision-makers cannot ignore the elephant in the room – nuclear power. The enormous cost of implementing 100 per cent renewable power is not realistic for most nations, so nuclear offers our best chance of making a low-carbon society achievable and affordable. Yet the incident at Fukushima earlier this year has reinforced some long-standing concerns.

Unlike road use or smoking, nuclear power stirs anxieties in many of us that are out of proportion with its true risks. This is not to be complacent about the potential danger of a nuclear plant, but it is striking that nuclear power has killed fewer than 5000 people in its entire history. Compare that with coal mining, which in just one year and in one country – China in 2006 – killed 4700.

Germany's decision to phase out all nuclear power as a result of Fukushima will most likely have unintended consequences. The Association of German Engineers has estimated that it will cost €53 billion every year in Germany to close down its nuclear generation and switch to 100 per cent renewable energy. It will be interesting to see how public opinion, now so clearly against nuclear power, responds as the economic costs become apparent.

Any technological revolution requires two crucial ingredients – engineers to design, develop and manufacture the technology, and politicians to help create the legislative, behavioural and societal environment that allows change to happen. Today's engineers have fulfilled their side of the bargain. It is time for our politicians to show their mettle.

Colin Brown *is director of engineering at the UK's Institution of Mechanical Engineers*

http://www.newscientist.com/article/dn20963-engineers-can-build-a-lowcarbon-world-if-we-let-them.html?full=true&print=true

Maker of cognitive training game seeks FDA approval

- 13:19 26 September 2011 by **Sujata Gupta**

Brain training? *(Image: Gary John Norman/Getty)*

Imagine walking away from a doctor's office with a prescription to play a video game. Brain Plasticity, the developer of a cognitive training game, has begun talks with the Food and Drug Administration (FDA) to market the game as a therapeutic drug.

Brain Plasticity has been fine-tuning a game to help people with schizophrenia improve the deficits in attention and memory that are often associated with the disorder.

Early next year, they will conduct a study with 150 participants at 15 sites across the country. Participants will play the game for one hour, five times a week over a period of six months. If participants' quality of life improves at that "dosage," Brain Plasticity will push ahead with the FDA approval process.

FDA approval for computer games in general – whether for schizophrenia or more common disorders such as depression or anxiety – could change the medical landscape, says Daniel Dardani, a technology licensing officer at the Massachusetts Institute of Technology.

But FDA involvement in the brain game industry will come with pros and cons. Panellists drawn from research and industry debated the issue at a meeting of the Entertainment Software and Cognitive Neurotherapeutics Society in San Francisco earlier this week.

Controversial industry

Some hope that an FDA stamp of approval will add integrity to a controversial industry. "The world of brain games is just full of bullshit," Michael Merzenich, co-founder of Posit Science, a developer of cognitive games told *New Scientist* at the meeting.

He points to a study last year showing that cognitive training games do nothing for brain fitness (*Nature*, DOI: 10.1038/nature09042). FDA involvement might help to single out those games with a demonstrable benefit.

But identifying beneficial games might be a complicated process. Since the *Nature* study was published, critics of the study have pointed out that the 11,430 participants were self-selected, healthy and did not follow a strict "dosing" regimen. They believe the games need to be tested more rigorously.

Unlike the cognitive tasks that featured in the *Nature* study, the Brain Plasticity game targets a specific section of the population and comes with stringent "dosage" requirements for how often and how long participants need to play to see results.

Game scrutiny

Even if the FDA gives approval for games like Brain Plasticity's, it might not scrutinise the many games that claim to firm up healthy people's brains, says Henry Mahncke, a senior scientist at Brain Plasticity.

Some worry that FDA approval would actually stymie development of cognitive training games, because the agency will be too slow to approve the minor tweaks that let games evolve. "I think it's premature to have the FDA get involved," says Alice Medalia, a cognitive remediation specialist at Columbia University in New York City.

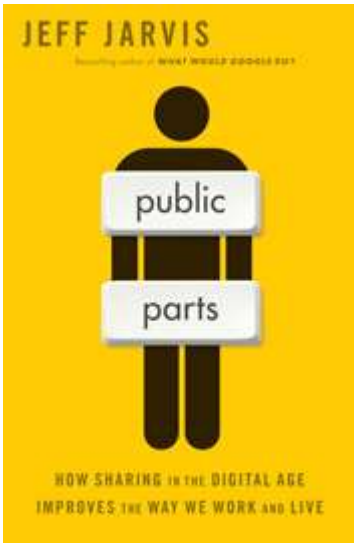
Compromise may be possible. The FDA could issue guidelines for what consumers should look for in a therapeutic gaming product – similar to its handling of medical smartphone apps, says Alvaro Fernandez, CEO of SharpBrains, a Washington DC-based market research firm that tracks non-invasive neuroscience tools.

http://www.newscientist.com/article/dn20962-maker-of-cognitive-training-game-seeks-fda-approval.html?full=true&print=true

Why put your personal info online?

11:00 26 September 2011
Books

Niall Firth, technology news editor



WHEN writer Jeff Jarvis decided to tell the world about his prostate cancer he didn't spare the gory details: he happily blogged about his "malfunctioning penis" after surgery, and the adult diaper he had to wear.

Too much information, some may say. Not for Jarvis. He is an outspoken advocate for living one's digital life in the open and his latest book, *Public Parts*, is one of the first to analyse the shift towards more transparency thanks to Facebook, Twitter and the other big names of this new digital age.

How do we define what is public and what is private? What are the benefits and dangers of living a life in which everything is shared? Jarvis explores these questions and more in his immensely readable, chatty style.

He also manages to gain an audience with Facebook founder Mark Zuckerberg, who shares Jarvis's essential vision that public is good, and sharing can be beneficial. Not everyone agrees, of course, and "privacy advocates" and politicians trying to stem the digital tide feel the lash of his tongue.

One of his most fascinating points is an extended analogy involving Gutenberg's printing press in the 15th century and how it revolutionised society. We are at now a similarly important turning point in our history - another Renaissance, Jarvis argues.

From revolutions in the Middle East to how some businesses are slowly coming to embrace "publicness", technology is enabling the sharing of information, the digital conversation, like never before in history. No one knows what's going to happen next. But people like Jarvis are having fun making sense of these confusing early years.

Book Information
*Public Parts*by Jeff Jarvis
Published by: Simon & Schuster
£17.99/$26.99

http://www.newscientist.com/blogs/culturelab/2011/09/why-put-your-personal-info-online.html

Carnivorous plant inspires super-slippery material

- 18:45 21 September 2011 by **Lisa Grossman**

A slippery slope. *(Image: Chi'en Lee/FLPA)*

Water, oil, blood and insects alike slide swiftly off a new super-slippery material inspired by a carnivorous plant.

Scientists searching for clever materials sometimes borrow ideas from nature. Lotus leaves, for example, are famously water repellant, thanks to their textured surfaces which trap a cushion of air for water to slide down.

The leaves have inspired a range of so-called "superhydrophobic" materials. But these materials have trouble repelling oils and more complex liquids, which have lower surface tensions than water and can seep into the surface at the slightest pressure.

"Everybody's talking about the lotus leaf," says Joanna Aizenberg of Harvard University, whose lab designs and builds biomimetic materials to solve a range of problems. "But it's just one of many strategies that nature created to manage and control the interaction with liquid."

Now, a new material takes a cue from one of the plant world's few meat-eaters: the carnivorous pitcher plant *Nepenthes*. The plants prey on insects, whose oily feet normally allow them to walk up walls. But pitchers' tube-shaped leaves have microscopic bumps that hold a thin layer of water in place. The water repels the oils, sending hapless insects slipping straight into their gaping mouths.

"They just step on the rim, and immediately slide into the digestive juices," Aizenberg says.

Aizenberg realized that with the right choice of lubricating liquid, the pitcher plant's strategy could be adapted to repel virtually anything.

The researchers started with a textured substrate, which could be almost anything that is rough on the nanoscale, Aizenberg says. One good choice is Teflon, a fibrous material that is widely thought to be super-slippery itself.

Filling in the bumps

Their most slippery surface resulted when they added a layer of the perfluorinated fluid 3M Fluorinert FC-70, manufactured by the firm 3M, to Teflon. The liquid oozed into all the pores in the Teflon, and left a nanometres-thin layer of liquid at the top. The material still feels dry to the touch, and other liquids simply hydroplane off the surface, like a car sliding off a wet road. The team calls the material 'slippery liquid-infused porous surfaces,' or SLIPS.

"We call it SLIPS, because everything does," Aizenberg says. The materials could be useful for making self-cleaning windows, friction-free oil and water transport pipes, and safe and efficient blood transfusion devices, she adds.

SLIPS beat the lotus leaf in several arenas. They're more slippery – liquids from water to oil to blood lose contact with the surface when it's tilted by an angle as shallow as 2 degrees, whereas liquids held to other surfaces tilted from 5 to 30 degrees. They can also recover from damage, because the lubricating liquid naturally seeps back in to any holes. And because liquid is incompressible, the material can be used at pressures equivalent to 7 kilometres underwater.

"It's interesting that it combines self-lubrication, self-healing and self-cleaning, which are different processes," says Michael Nosonovsky of the University of Wisconsin-Milwaukee. "It's a new type of smart material."

Journal reference: *Nature*, DOI: 10.1038/nature10447

http://www.newscientist.com/article/dn20947-carnivorous-plant-inspires-superslippery-material.html

Groundwater greed driving sea level rises

- 25 September 2011 by **Michael Marshall**
- Magazine issue 2831. **Subscribe and save**

SLOWLY and almost imperceptibly the seas are rising, swollen by melting ice and the expansion of seawater as it warms. But there's another source of water adding to the rise: humanity's habit of pumping water from underground aquifers to the surface. Most of this water ends up in the sea.

Not many scientists even consider the effects of groundwater on sea level, says Leonard Konikow of the United States Geological Survey in Reston, Virginia. Estimates were published as far back as 1994 (*Nature*, DOI: 10.1038/367054a0), but without good evidence to back them up, he says. The last report of the Intergovernmental Panel on Climate Change said that changes to groundwater reserves "cannot be estimated with much confidence".

Konikow measured how much water had ended up in the oceans by looking at changes in groundwater levels in 46 well-studied aquifers, which he then extrapolated to the rest of the world. He estimates that about 4500 cubic kilometres of water was extracted from aquifers between 1900 and 2008.

That amounts to 1.26 centimetres of the overall rise in sea levels of 17 cm in the same period (*Geophysical Research Letters*, DOI: 10.1029/2011gl048604).

That 1.26 cm may not seem like much, but groundwater depletion has accelerated massively since 1950, particularly in the past decade. Over 1300 cubic kilometres of the groundwater was extracted between 2000 and 2008, producing 0.36 cm of the total 2.79-cm rise in that time. "I was surprised that the depletion has accelerated so much," Konikow says.

It's not clear if the acceleration will continue. Konikow points out that some developed countries are cutting back on aquifer use and even trying to refill them when there is plenty of rainfall. "I would like to see that implemented more," he says.

"While there remain significant uncertainties, Konikow's estimate is probably the best there is for groundwater depletion," says John Church of CSIRO Marine and Atmospheric Research in Hobart, Tasmania, Australia.

Konikow, Church and colleagues have used the data to compare the contributions of the different sources of sea-level rise and found that aquifer depletion is almost as significant as the ice melt in Greenland and Antarctica combined (*Geophysical Research Letters*, DOI: 10.1029/2011gl048794)

http://www.newscientist.com/article/mg21128314.700-groundwater-greed-driving-sea-level-rises.html?full=true&print=true

Five easy mutations to make bird flu a lethal pandemic

- 26 September 2011 by **Debora MacKenzie**

Magazine issue 2831.

A short journey from hens to humans *(Image: Sonny Tumbelaka/AFP/Getty Images)*

Editorial: "The risk of an influenza pandemic is fact, not fiction"

H5N1 bird flu can kill humans, but has not gone pandemic because it cannot spread easily among us. That might change: five mutations in just two genes have allowed the virus to spread between mammals in the lab. What's more, the virus is just as lethal despite the mutations.

"The virus is transmitted as efficiently as seasonal flu," says Ron Fouchier of the Erasmus Medical Centre in Rotterdam, the Netherlands, who reported the work at a scientific meeting on flu last week in Malta.

"This shows clearly that H5 can change in a way that allows transmission and still cause severe disease in humans. It's scary," says Peter Doherty, a 1996 Nobel prizewinner for work in viral immunology.

H5N1 evolved in poultry in east Asia and has spread across Eurasia since 2004. In that time 565 people are known to have caught it; 331 died. No strain that spreads readily among mammals has emerged in that time, despite millions of infected birds, and infections in people, cats and pigs. Efforts to create such a virus in the lab have failed, and some virologists think H5N1 simply cannot do it.

The work by Fouchier's team suggests otherwise. They first gave H5N1 three mutations known to adapt bird flu to mammals. This version of the virus killed ferrets, which react to flu viruses in a similar way to humans. The virus did not transmit between them, though.

Then the researchers gave the virus from the sick ferrets to more ferrets - a standard technique for making pathogens adapt to an animal. They repeated this 10 times, using stringent containment. The tenth round of ferrets shed an H5N1 strain that spread to ferrets in separate cages - and killed them.

The process yielded viruses with many new mutations, but two were in all of them. Those plus the three added deliberately "suggest that as few as five are required to make the virus airborne", says Fouchier. He will now test H5N1 made with only those five.

All the mutations have been seen separately in H5N1 from birds. "If they occur separately, they can occur together," says Fouchier. Malik Peiris of the University of Hong Kong, a flu virologist, says this means H5N1 transmissible between humans can evolve in birds, where it is circulating already, without needing to spend time in mammals such as pigs.

Peter Palese, a flu specialist at Mount Sinai Medical Center in New York City who has expressed doubts that H5N1 can adapt to mammals, is not convinced.

"Ferrets are not humans," he says. "H5N1 has been around for a long time" and failed to mutate into a form that can jump between people.

"That it has not adapted doesn't mean it cannot," replies Jeffery Taubenberger of the US National Institutes of Health in Bethesda, Maryland, who studies how a bird flu became the deadly pandemic of 1918.

"It simply means that so far it has not - luckily for us."

http://www.newscientist.com/article/mg21128314.600-five-easy-mutations-to-make-bird-flu-a-lethal-pandemic.html

The risk of an influenza pandemic is fact, not fiction

- 26 September 2011
- Magazine issue 2831.

SOME people don't seem to believe anything they're told about flu. You'll often hear that the swine flu pandemic of 2009, along with the spectre of H5N1 bird flu, were "scares" backed by some conspiracy or other.

Of course, the 2009 pandemic was real, it just wasn't as bad as it could have been. Bird flu is about as bad as flu can get, and the only thing that has kept it at bay has been its inability to spread easily between people.

That may have been a temporary situation. Work reported last week suggests that just a few mutations could make H5N1 highly contagious in humans without losing its ability to kill 60 per cent of those it infects (see "Five easy mutations to make bird flu a lethal pandemic").

Now more than ever, the world needs its flu defences to be in order. The 2009 pandemic showed they aren't, with vaccine arriving late, in relatively few countries. And because the pandemic was limited, investment to improve vaccines is far from booming.

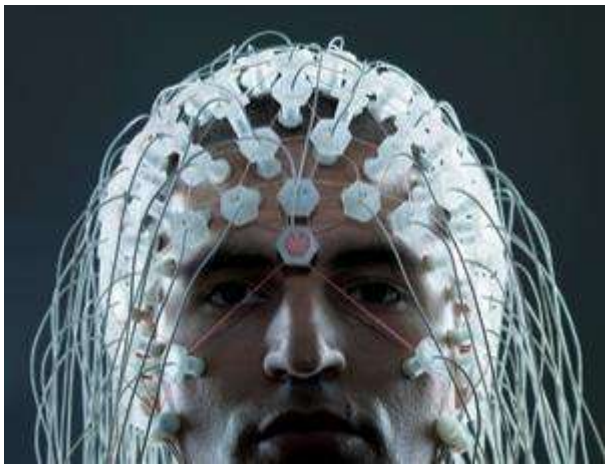
It should be. If vaccines are not ready fast enough after the next pandemic hits, there will still be conspiracy theories, but the "scare" will be all too real.

http://www.newscientist.com/article/mg21128313.300-the-risk-of-an-influenza-pandemic-is-fact-not-fiction.html?full=true&print=true

Habits form when brainwaves slow down

- 20:00 26 September 2011 by **Wendy Zukerman**

Magazine issue 2831.



What might be possible when we tweak our own brainwaves? *(Image: Adrianna Williams/Corbis)*

Habits may be difficult to change, but now at least we have an insight into how they form.

When a group of neurons fire simultaneously, the activity appears as a brainwave. Different brainwave-frequencies are linked to different tasks in the brain.

To track how brainwaves change during learning, Ann Graybiel and Mark Howe at the Massachusetts Institute of Technology used electrodes to analyse brainwaves in the ventromedial striatum of rats while they were taught to navigate a maze.

As rats were learning the task their brain activity showed bursts of fast gamma waves. Once the rats mastered the task, their brainwaves slowed to almost a quarter of their initial frequency, becoming beta waves. Graybiel's team suspects this transition reflects when learning becomes habit.

Graybiel says the slower brainwaves may be the brain weeding out excess activity to refine behaviour. She suggests it might be possible to boost the rate at which you learn a skill by enhancing such beta-wave activity.

Journal reference: *Proceedings of the National Academy of Sciences*, DOI: 10.1073/pnas.1113158108

http://www.newscientist.com/article/dn20964-habits-form-when-brainwaves-slow-down.html?full=true&print=true

A brief history of the brain

- 26 September 2011 by **David Robson**

Magazine issue 2831.

Intelligent origins *(Image: Burn Everything/Agency Rush)*

New Scientist *tracks the evolution of our brain from its origin in ancient seas to its dramatic expansion in one ape – and asks why it is now shrinking*

IT IS 30,000 years ago. A man enters a narrow cave in what is now the south of France. By the flickering light of a tallow lamp, he eases his way through to the furthest chamber. On one of the stone overhangs, he sketches in charcoal a picture of the head of a bison looming above a woman's naked body.

In 1933, Pablo Picasso creates a strikingly similar image, called *Minotaur Assaulting Girl*.

That two artists, separated by 30 millennia, should produce such similar work seems astonishing. But perhaps we shouldn't be too surprised. Anatomically at least, our brains differ little from those of the people who painted the walls of the Chauvet cave all those years ago. Their art, part of the "creative explosion" of that time, is further evidence that they had brains just like ours.

How did we acquire our beautiful brains? How did the savage struggle for survival produce such an extraordinary object? This is a difficult question to answer, not least because brains do not fossilise. Thanks to the latest technologies, though, we can now trace the brain's evolution in unprecedented detail, from a time before the very first nerve cells right up to the age of cave art and cubism.

The story of the brain begins in the ancient oceans, long before the first animals appeared. The single-celled organisms that swam or crawled in them may not have had brains, but they did have sophisticated ways of sensing and responding to their environment. "These mechanisms are maintained right through to the evolution of mammals," says Seth Grant at the Wellcome Trust Sanger Institute in Cambridge, UK. "That's a very deep ancestry."

The evolution of multicellular animals depended on cells being able to sense and respond to other cells - to work together. Sponges, for example, filter food from the water they pump through the channels in their bodies. They can slowly inflate and constrict these channels to expel any sediment and prevent them clogging

up. These movements are triggered when cells detect chemical messengers like glutamate or GABA, pumped out by other cells in the sponge. These chemicals play a similar role in our brains today (*Journal of Experimental Biology*, vol 213, p 2310).

Releasing chemicals into the water is a very slow way of communicating with distant cells - it can take a good few minutes for a demosponge to inflate and close its channels. Glass sponges have a faster way: they shoot an electrical pulse across their body that makes all the flagellae that pump water through their bodies stop within a matter of seconds (*Nature*, vol 387, p 29).

This is possible because all living cells generate an electrical potential across their membranes by pumping out ions. Opening up channels that let ions flow freely across the membrane produces sudden changes in this potential. If nearby ion channels also open up in response, a kind of Mexican wave can travel along a cell's surface at speeds of several metres a second. Since the cells in glass sponges are fused together, these impulses can travel across their entire bodies.

Deep roots

Recent studies have shown that many of the components needed to transmit electrical signals, and to release and detect chemical signals, are found in single-celled organisms known as choanoflagellates. That is significant because ancient choanoflagellates are thought to have given rise to animals around 850 million years ago.

So almost from the start, the cells within early animals had the potential to communicate with each other using electrical pulses and chemical signals. From there, it was not a big leap for some cells to become specialised for carrying messages.

These nerve cells evolved long, wire-like extensions - axons - for carrying electrical signals over long distances. They still pass signals on to other cells by releasing chemicals such as glutamate, but they do so where they meet them, at synapses. That means the chemicals only have to diffuse across a tiny gap, greatly speeding things up. And so, very early on, the nervous system was born.

The first neurons were probably connected in a diffuse network across the body (see diagram). This kind of structure, known as a nerve net, can still be seen in the quivering bodies of jellyfish and sea anemones.

But in other animals, groups of neurons began to appear - a central nervous system. This allowed information to be processed rather than merely relayed, enabling animals to move and respond to the environment in ever more sophisticated ways. The most specialised groups of neurons - the first brain-like structure - developed near the mouth and primitive eyes.

Our view of this momentous event is hazy. According to many biologists, it happened in a worm-like creature known as the urbilaterian (see diagram), the ancestor of most living animals including vertebrates, molluscs and insects. Strangely, though, some of its descendants, such as the acorn worm, lack this neuronal hub.

It is possible the urbilaterian never had a brain, and that it later evolved many times independently. Or it could be that the ancestors of the acorn worm had a primitive brain and lost it - which suggests the costs of building brains sometimes outweigh the benefits.

Either way, a central, brain-like structure was present in the ancestors of the vertebrates. These primitive, fish-like creatures probably resembled the living lancelet, a jawless filter-feeder. The brain of the lancelet barely stands out from the rest of the spinal cord, but specialised regions are apparent: the hindbrain controls its swimming movements, for instance, while the forebrain is involved in vision. "They are to vertebrates what a

small country church is to Notre Dame cathedral - the basic architecture is there though they lack a lot of the complexity," says Linda Holland at the University of California, San Diego.

Some of these fish-like filter feeders took to attaching themselves to rocks. The swimming larvae of sea squirts have a simple brain but once they settle down on a rock it degenerates and is absorbed into the body.

We would not be here, of course, if our ancestors had not kept swimming. And around 500 million years ago, things went wrong when one of them was reproducing, resulting in its entire genome getting duplicated. In fact, this happened not just once but twice.

These accidents paved the way for the evolution of more complex brains by providing plenty of spare genes that could evolve in different directions and take on new roles. "It's like the time your parents bought you the biggest Lego kit - with loads of different components to use in different combinations," says Grant. Among many other things, it enabled different brain regions to express different types of neurotransmitter, which in turn allowed more innovative behaviours to emerge.

As early fish struggled to find food and mates, and dodge predators, many of the core structures still found in our brains evolved: the optic tectum, involved in tracking moving objects with the eyes; the amygdala, which helps us to respond to fearful situations; parts of the limbic system, which gives us our feelings of reward and helps to lay down memories; and the basal ganglia, which control patterns of movements (see diagram).

Brainy mammals

By 360 million years ago, our ancestors had colonised the land, eventually giving rise to the first mammals about 200 million years ago. These creatures already had a small neocortex - extra layers of neural tissue on the surface of the brain responsible for the complexity and flexibility of mammalian behaviour. How and when did this crucial region evolve? That remains a mystery. Living amphibians and reptiles do not have a direct equivalent, and since their brains do not fill their entire skull cavity, fossils tell us little about the brains of our amphibian and reptilian ancestors.

What is clear is that the brain size of mammals increased relative to their bodies as they struggled to contend with the dinosaurs. By this point, the brain filled the skull, leaving impressions that provide tell-tale signs of the changes leading to this neural expansion.

Timothy Rowe at the University of Texas at Austin recently used CT scans to look at the brain cavities of fossils of two early mammal-like animals, *Morganucodon* and *Hadrocodium*, both tiny, shrew-like creatures that fed on insects. This kind of study has only recently become feasible. "You could hold these fossils in your hands and know that they have answers about the evolution of the brain, but there was no way to get inside them non-destructively," he says. "It's only now that we can get inside their heads."

Rowe's scans revealed that the first big increases in size were in the olfactory bulb, suggesting mammals came to rely heavily on their noses to sniff out food. There were also big increases in the regions of the neocortex that map tactile sensations - probably the ruffling of hair in particular - which suggests the sense of touch was vital too (*Science*, vol 332, p 955). The findings fit in beautifully with the widely held idea that early mammals were nocturnal, hiding during the day and scurrying around in the undergrowth at night when there were fewer hungry dinosaurs running around.

After the dinosaurs were wiped out, about 65 million years ago, some of the mammals that survived took to the trees - the ancestors of the primates. Good eyesight helped them chase insects around trees, which led to an expansion of the visual part of the neocortex. The biggest mental challenge, however, may have been keeping track of their social lives.

If modern primates are anything to go by, their ancestors likely lived in groups. Mastering the social niceties of group living requires a lot of brain power. Robin Dunbar at the University of Oxford thinks this might explain the enormous expansion of the frontal regions of the primate neocortex, particularly in the apes. "You need more computing power to handle those relationships," he says. Dunbar has shown there is a strong relationship between the size of primate groups, the frequency of their interactions with one another and the size of the frontal neocortex in various species.

Besides increasing in size, these frontal regions also became better connected, both within themselves, and to other parts of the brain that deal with sensory input and motor control. Such changes can even be seen in the individual neurons within these regions, which have evolved more input and output points.

All of which equipped the later primates with an extraordinary ability to integrate and process the information reaching their bodies, and then control their actions based on this kind of deliberative reasoning. Besides increasing their overall intelligence, this eventually leads to some kind of abstract thought: the more the brain processes incoming information, the more it starts to identify and search for overarching patterns that are a step away from the concrete, physical objects in front of the eyes.

Which brings us neatly to an ape that lived about 14 million years ago in Africa. It was a very smart ape but the brains of most of its descendants - orang-utans, gorillas and chimpanzees - do not appear to have changed greatly compared with the branch of its family that led to us. What made us different?

It used to be thought that moving out of the forests and taking to walking on two legs lead to the expansion of our brains. Fossil discoveries, however, show that millions of years after early hominids became bipedal, they still had small brains.

We can only speculate about why their brains began to grow bigger around 2.5 million years ago, but it is possible that serendipity played a part. In other primates, the "bite" muscle exerts a strong force across the whole of the skull, constraining its growth. In our forebears, this muscle was weakened by a single mutation, perhaps opening the way for the skull to expand. This mutation occurred around the same time as the first hominids with weaker jaws and bigger skulls and brains appeared (*Nature*, vol 428, p 415).

Once we got smart enough to innovate and adopt smarter lifestyles, a positive feedback effect may have kicked in, leading to further brain expansion. "If you want a big brain, you've got to feed it," points out Todd Preuss of Emory University in Atlanta, Georgia.

He thinks the development of tools to kill and butcher animals around 2 million years ago would have been essential for the expansion of the human brain, since meat is such a rich source of nutrients. A richer diet, in turn, would have opened the door to further brain growth.

Primatologist Richard Wrangham at Harvard University thinks that fire played a similar role by allowing us to get more nutrients from our food. Eating cooked food led to the shrinking of our guts, he suggests. Since gut tissue is expensive to grow and maintain, this loss would have freed up precious resources, again favouring further brain growth.

Mathematical models by Luke Rendell and colleagues at the University of St Andrews in the UK not only back the idea that cultural and genetic evolution can feed off each other, they suggest this can produce extremely strong selection pressures that lead to "runaway" evolution of certain traits. This type of feedback might have played a big role in our language skills. Once early humans started speaking, there would be strong selection for mutations that improved this ability, such as the famous *FOXP2* gene, which enables the basal ganglia and the cerebellum to lay down the complex motor memories necessary for complex speech.

The overall picture is one of a virtuous cycle involving our diet, culture, technology, social relationships and genes. It led to the modern human brain coming into existence in Africa by about 200,000 years ago.

Evolution never stops, though. According to one recent study, the visual cortex has grown larger in people who migrated from Africa to northern latitudes, perhaps to help make up for the dimmer light up there (*Biology Letters*, DOI: 10.1098/rsbl.2011.0570).

Downhill from here

So why didn't our brains get ever bigger? It may be because we reached a point at which the advantages of bigger brains started to be outweighed by the dangers of giving birth to children with big heads. Or it might have been a case of diminishing returns.

Our brains are pretty hungry, burning 20 per cent of our food at a rate of about 15 watts, and any further improvements would be increasingly demanding. Simon Laughlin at the University of Cambridge compares the brain to a sports car, which burns ever more fuel the faster it goes.

One way to speed up our brain, for instance, would be to evolve neurons that can fire more times per second. But to support a 10-fold increase in the "clock speed" of our neurons, our brain would need to burn energy at the same rate as Usain Bolt's legs during a 100-metre sprint. The 10,000-calorie-a-day diet of Olympic swimmer Michael Phelps would pale in comparison.

Not only did the growth in the size of our brains cease around 200,000 years ago, in the past 10,000 to 15,000 years the average size of the human brain compared with our body has shrunk by 3 or 4 per cent. Some see this as no cause for concern. Size, after all, isn't everything, and it's perfectly possible that the brain has simply evolved to make better use of less grey and white matter. That would seem to fit with some genetic studies, which suggest that our brain's wiring is more efficient now than it was in the past.

Others, however, think this shrinkage is a sign of a slight decline in our general mental abilities. David Geary at the University of Missouri-Columbia, for one, believes that once complex societies developed, the less intelligent could survive on the backs of their smarter peers, whereas in the past, they would have died - or at least failed to find a mate.

This decline may well be continuing. Many studies have found that the more intelligent people are, the fewer children they tend to have. More than ever before, intellectual and economic success are not linked with having a bigger family. If it were, says Rendell, "Bill Gates would have 500 children."

This evolutionary effect would result in a decline of about 0.8 IQ points per generation in the US if you exclude the effects of immigration, a 2010 study concluded (*Intelligence*, vol 38, p 220). However, nurture matters as well as nature: even if this genetic effect is real, it has been more than compensated for by improved healthcare and education, which led a steady rise in IQ during most of the 20th century.

Crystal-ball gazing is always a risky business, and we have no way of knowing the challenges that humanity will face over the next millennia. But if they change at all, it appears likely that our brains are going keep "devolving" - unless, of course, we step in and take charge.

The feathered apes

Would intelligent dinosaurs rule the world if a meteorite impact had not wiped out their kind?

We cannot answer that question, of course, but there is no doubt that dinosaurs had the potential to evolve into very smart animals. The proof is sitting in a tree near you.

Certain birds, particularly the crow family, have evolved complex behaviours that match the ingenuity of many primates. Tool use, deception, face recognition - you name it, they can do it. Why are some birds so brainy? Stig Walsh at the National Museums Scotland, thinks that foundations were laid in their dinosaur ancestors, which probably climbed around in trees before eventually taking to the air. This behaviour would have favoured the same abilities that evolved in the tree-climbing primates: excellent vision, motor coordination and balance, which came about through the expansion of the brain areas known as the optic tectum and the cerebellum.

To compete with other animals, these tree-climbing dinosaurs might have also begun to evolve new foraging strategies that needed more brain power, leading to the growth of the forebrain. There are plenty of fossils of dinosaurs, he says, whose brains already possess some of these enlarged structures.

So the ancestors of birds had relatively big brains compared with their body size, and their brains grew proportionately even bigger once they took to the air and evolved even more advanced behaviours. These abilities might have enabled them to survive the mass extinction that killed the other dinosaurs, Walsh says, since their ingenuity would have helped them to find new ways of foraging for food in the wake of the catastrophe.

Bird brains are structured in a very different way to mammalian ones. The mammalian lineage developed new outer layers, known as the neocortex, which birds lack. Despite this, it is likely that the enlarged frontal cortex of the mammals, and the enlarged forebrain of the birds, perform similar functions. "There's been a convergence, along different routes," says Walsh.

How smart could birds get? For all the tool-making talents of crows, a beak is clearly not as good for manipulating objects as the hands of primates. That may limit the development of bird brains, though some have speculated that the wings of ground-living birds could yet re-evolve grasping forelimbs.

David Robson *is a features editor at New Scientist*

http://www.newscientist.com/article/mg21128311.800-a-brief-history-of-the-brain.html

'Gloomy' gene may make you more positive

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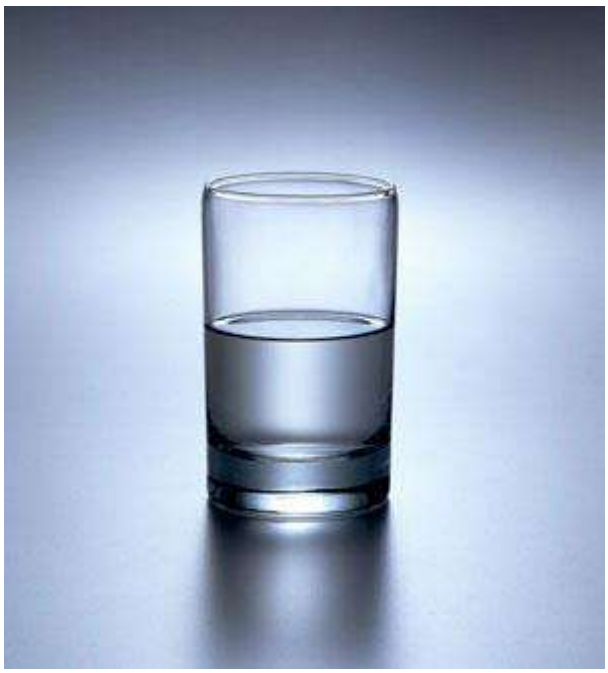

IS THE glass half full or half empty? A gene variant usually considered to make people more gloomy could also help them see the positive.

Previous studies have linked the short version of the 5-HTTLPR serotonin-transporter gene with vulnerability and depression, in contrast to the "happier" carriers of the long version.

To explore further, Elaine Fox at the University of Essex in Colchester, UK, and colleagues asked 62 people with the short variant and 54 with the long version to perform computer exercises that tested how quickly they could identify a target superimposed either on a positive or negative image shown side by side. Unknown to the volunteers, in some exercises the team always flashed the target either on the positive or the negative image.

People with the short variant adapted to this unconscious bias, identifying the target 40 to 60 milliseconds faster than when the target was randomly assigned. The reactions of long-variant volunteers barely changed (*Biological Psychiatry*, DOI: 10.1016/j.biopscych.2011.07.004).

"The short version is not just a vulnerability variant," says Fox. It could also be an "opportunity" gene, she says, suggesting that these people are more responsive to emotion, both positive and negative.

http://www.newscientist.com/article/mg21128305.000-gloomy-gene-may-make-you-more-positive.html?full=true&print=true

Resurrected ancient protein is a potent antibiotic

- 24 September 2011 by **Wendy Zukerman**
- Magazine issue 2831.

How clean is my pouch? *(Image: Tom Brakefield/Getty)*

IF MODERN medicine cannot provide an answer to multidrug-resistant microbes, perhaps ancient animals can. Biologists have resurrected a mammalian antimicrobial compound that was last seen on Earth 59 million years ago when mammals were recovering from the Cretaceous-Tertiary extinction that wiped out the dinosaurs. Even now it is potent enough to destroy some of our most troublesome pathogens.

Last year the Infectious Diseases Society of America launched an initiative with the aim of producing 10 antibiotics to tackle multidrug-resistant bugs by 2020. The lower reaches of the tree of life are being explored for those antibiotics, says Ben Cocks of La Trobe University in Bundoora, Australia.

Already, promising molecules have been found in the tissues of primitive fish called lampreys (*Proceedings of the National Academy of Sciences*, DOI: 10.1073/pnas.1108558108).

Such an approach is effective because these molecules are so simple, says Cocks. Conventional antibiotics target precise flaws in a pathogen's armour, such as a particular enzyme. This is similar to how the adaptive immune system found in vertebrates works: it learns how to fight a new pathogen and then remembers the lesson for future battles. The trouble is that the pathogens patch their armour, requiring the immune system - and drug companies - to identify new weaknesses.

Cocks says this evolutionary arms race can be side-stepped by falling back on the cruder innate immune system that is found in all plants and animals - and which has largely been ignored in our fight with multidrug-resistant pathogens.

The molecules of the innate immune system use simple chemistry to target the lipids in cell membranes. They can either disrupt and weaken bacterial membranes, or subtly alter the properties of the host's healthy cells so that pathogens can no longer attack them.

But there's a problem: animals with the strongest innate immune systems tend to be so distantly related to humans that molecules taken from them can have toxic effects in humans. Cocks's solution is to study the

mammals with the best innate immune systems, the molecules of which are more likely to be compatible with humans. His work has taken him inside the wallaby's pouch.

As marsupials, wallabies give birth to young at a much earlier stage in their development than placental mammals. For example, the tammar wallaby, *Macropus eugenii*, is born after 26 days, equivalent to a 6-week-old human fetus. The tiny wallabies then crawl into their mother's pouch to grow larger.

"It's not a clean environment," says Cocks. Bacteria closely related to the superbugs affecting humans in hospitals have been found in the wallaby pouch. But the baby wallabies are so underdeveloped that they lack an adaptive immune system to fight them; their survival depends on their innate immune system.

Cocks's team scoured the wallaby genome and found genes that code for 14 cathelicidin peptides, a component of the innate immune system. Lab tests revealed that many of the peptides could kill a range of multidrug-resistant pathogens - without damaging human cells.

The team noticed that genes in five of the cathelicidins were remarkably similar and probably evolved from a single ancestor. "We thought that the ancestral form would have a special broad-range activity," says Cocks.

Using the changes within the five peptides, Cocks and his collaborators at the University of Sydney, Australia, worked backwards to predict the genetic sequence that codes for the original peptide. His team then used it to produce a synthetic version of the peptide, effectively resurrecting it.

"The amazing thing was that it worked well against a broad range of pathogens," he says. Lab tests showed it destroyed six of seven multidrug-resistant bacteria, and was 10 to 30 times more potent than modern antibiotics such as tetracycline (*PLoS One*, DOI: 10.1371/journal.pone.0024030).

"This is really significant," Cocks says. "Now we have access to ancient peptides for future drug development."

Damian Dowling at Monash University in Melbourne, Australia, says some ancient and extinct peptides might be more effective than those found in living creatures because bacteria haven't been exposed to them for millions of years. "Even if the bacteria once developed resistance against the peptide, it has probably lost it," he says.

http://www.newscientist.com/article/mg21128314.800-resurrected-ancient-protein-is-a-potent-antibiotic.html?full=true&print=true

Bubble Trouble
Henry Farrell | August 30, 2011

In a 2009 book about the social consequences of the Internet, *The Age of the Infovore*, the economist and blogger Tyler Cowen argues that new technologies enable us to decide what information to consume and, as a result, to remake ourselves. Instead of reading the same newspaper or watching the same television news, we can use new technologies to choose an idiosyncratic mix of sources and create our own unique micro-economy of information that not only reflects our tastes but helps us continually reshape them.

In his new book, *The Filter Bubble*, Eli Pariser looks at the same facts as Cowen but interprets them differently. What Cowen sees as enhancing individual autonomy, Pariser sees as restricting personal development. Instead of constructing personal micro-economies that allow us to make sense of complexity, we are turning media into a mirror that reflects our own prejudices back at us. Even worse, services like Google and Facebook distort the mirror so that it exaggerates our grosser characteristics. Without our knowing, they reshape our information worlds according to their interpretation of our interests. Few people are aware that when they look up a topic in Google, their searches are personalized. Google infers what people want from their past searching behavior and skews results accordingly.

We are beginning to live in what Pariser calls "filter bubbles," personalized micro-universes of information that overemphasize what we want to hear and filter out what we don't. Not only are we unaware of the information that is filtered out, but we are unaware that we are unaware. Our personal economies of information seem complete despite their deficiencies. Personal decisions contribute to this pattern, and ever more sophisticated technologies add to it. Google's understanding of our tastes and interests is still a crude one, but it shapes the information that we find via Google searches. And because the information we are exposed to perpetually reshapes our interests, we can become trapped in feedback loops: Google's perception of what we want to read shapes the information we receive, which in turn affects our interests and browsing behavior, providing Google with new information. The result, Pariser suggests, may be "a static ever-narrowing version of yourself."

This self-reinforcement may have unhappy consequences for politics. Pariser, who is inspired by the philosophy of John Dewey, argues that ideological opponents need to agree on facts and understand each other's point of view if democracy is to work well. Exposure to the other side allows for the creation of a healthy "public" that can organize around important public issues. Traditional media, in which editors choose stories they believe to be of public interest, have done this job better than do trivia-obsessed new media. Furthermore, intellectual cocooning may stifle creativity, which is spurred by the collision of different ways of thinking about the world. If we are not regularly confronted with surprising facts and points of view, we are less likely to come up with innovative solutions.

The Filter Bubble is an excellent book in a genre usually given to ill-informed pontification. It draws extensively on the relevant research literature but isn't overwhelmed by it. The book is cogently argued and clearly written by someone endeavoring to counter his own ways of filtering the world. Pariser is a technology geek and the former executive director of MoveOn, an online organization that has many virtues but is not distinguished for an intellectually nuanced understanding of the other side's perspective. The book challenges ready partisanship and the standard geek assumption that technology is somehow both politically liberating and politically neutral.

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EVEN SO, PARISER'S CASE is not as watertight as it might seem. Some evidence does suggest that the Internet makes people more likely to select politically congenial sources of information. For example, my own work with Eric Lawrence and John Sides shows that depending on their perspective, readers of political blogs tend to follow either left-wing or right-wing blogs and also have unusually strong and ideologically consistent political views.

Blog readers, however, are a self-selecting group who may have had strong political opinions before they knew what a blog was. Other research by economists Matthew Gentzkow and Jesse Shapiro suggests that the broader public reads an ideologically diverse set of online news sources. Indeed, Gentzkow and Shapiro suggest that this wider population may be more exposed to different points of view via online media than they are through their personal interactions with friends, family, and co-workers. This exposure does not mean that online information necessarily counteracts offline prejudices. People may be primed to believe fellow partisans more than they believe neutral or antagonistic sources of information. Yet it does make the story more complicated than the one that Pariser is telling.

Moreover, Pariser's own activism provides evidence that there is a Deweyan case in favor of new media as well as against it. MoveOn came into being to counteract the traditional media's obsession with Bill Clinton's sex scandals. The group later became a mass phenomenon because it helped organize the opposition to the Iraq War at a moment when traditional media were echoing the Bush administration's false alarm about Iraq's nuclear program and were giving us reports from journalists embedded with the troops. For sure, MoveOn was partisan and uninterested in subtlety, but it would not have become a mass movement if it had focused its energies on talking to the other side. Political science research by Diana Mutz and others suggests that there is a direct tradeoff between deliberation and political engagement. The more that people take opposing points of view into consideration, the less likely they are to be politically active. If we want to see politically active publics, we may have to forgo some deliberation.

When Pariser argues that the dissemination of information has political consequences, he is right. He is also persuasive in arguing that filter-bubble problems cannot be solved easily through individual action. When Pariser himself sought to broaden his ideological horizons through "friending" conservatives on Facebook, he found that Facebook systematically failed to include their updates in his main feed. Since he clicked on these links less often, Facebook inferred that he wasn't interested in them and calibrated his information diet accordingly. As long as dominant businesses have incentives to give us what they think we want, individuals will have difficulty in breaking through the bubble on their own. The businesses aren't wrong: Most people don't enjoy having their basic preconceptions regularly challenged. They like their bubbles.

As a result, Cowen's ideal world—where the private vice of self-centered information leads to the public virtue of a lively interactive culture—is unlikely to be self-sustaining. It's also difficult to see how regulation could pop information bubbles. Pariser suggests that the government should introduce Fair Information Practices to give individuals some control over the use of their information. Such practices were first articulated in the very different world of the 1970s, when privacy activists worried about how static databases of personal information could be misused. But in a world where people happily inhabit their own bubbles, how exactly is this going to work? As Pariser himself argues, even Google can't understand exactly how its algorithms work in practice, let alone easily explain them to individuals without any technical background.

Competitive elections and democracy provide at least a partial antidote to this development. Information bubbles are hardly new, even though they now take new forms. In many societies, political parties long created information bubbles. Nineteenth-century America had partisan newspapers. In many 20th-century European countries, Social Democrats read Social Democratic newspapers, went to Social Democratic social clubs, joined Social Democratic trade unions, married other Social Democrats, and had Social Democratic babies. Christian Democrats and Communists had their own separate worlds. Nonetheless, democracy somehow kept working. As Harvard political theorist Nancy Rosenblum has argued, partisanship creates its own checks and balances. As long as partisans are contending for a majority of public support, they have to

temper their own beliefs in ways that will allow them to appeal to the public and to respond to potentially persuasive arguments from their opponents. This is far from perfect (the public has its own problems). Nonetheless, as John Stuart Mill argued, it can sometimes bring us closer to the truth.

Democratic competition is not a complete solution. It does not protect individuals from a narrowing of their horizons. It would be a good thing if Google and Facebook deliberately injected "inefficient" connections into online social networks and search results to encourage people to follow new paths, but it's not likely to happen. Even so, democracies are far more robust against information bubbles than Pariser believes. After all, they've survived bubbles for hundreds of years.

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Henry Farrell is associate professor of political science and international affairs at the George Washington University. He blogs at Crooked Timber and The Monkey Cage.

http://prospect.org/cs/articles?article=bubble_trouble

Invasion of Genomic Parasites Triggered Modern Mammalian Pregnancy, Study Finds

Pregnant highland cow. Genetic parasites invaded the mammalian genome more than 100 million years ago and dramatically changed the way mammals reproduce -- transforming the uterus in the ancestors of humans and other mammals from the production of eggs to a nurturing home for developing young, a new Yale University study has found. (Credit: © Ruud Morijn / Fotolia)

ScienceDaily (Sep. 26, 2011) — Genetic parasites invaded the mammalian genome more than 100 million years ago and dramatically changed the way mammals reproduce -- transforming the uterus in the ancestors of humans and other mammals from the production of eggs to a nurturing home for developing young, a new Yale University study has found.

The findings published online Sept. 25 in the journal *Nature Genetics* describe in unprecedented detail the molecular changes that allowed mammals to carry their developing young within the safety of the womb rather than laying them in nests or carrying them around in pouches.

"In the last two decades there have been dramatic changes in our understanding of how evolution works," said Gunter Wagner, the Alison Richard Professor of Ecology and Evolutionary Biology (EEB) and senior author of the paper. "We used to believe that changes only took place through small mutations in our DNA that accumulated over time. But in this case we found a huge cut-and-paste operation that altered wide areas of the genome to create large-scale morphological change."

The Yale team studying the evolutionary history of pregnancy looked at cells found in the uterus associated with placental development. They compared the genetic make-up of these cells in opossums -- marsupials that give birth two weeks after conception -- to armadillos and humans, distantly related mammals with highly developed placentas that nurture developing fetuses for nine months.

They found more than 1500 genes that were expressed in the uterus solely in the placental mammals. Intriguingly, note the researchers, the expression of these genes in the uterus is coordinated by transposons -- essentially selfish pieces of genetic material that replicate within the host genome and used to be called junk DNA.

"Transposons grow like parasites that have invaded the body, multiplying and taking up space in the genome," said Vincent J. Lynch, research scientist in EEB and lead author of the paper.

But they also activate or repress genes related to pregnancy, he said.

"These transposons are not genes that underwent small changes over long periods of time and eventually grew into their new role during pregnancy," Lynch said. "They are more like prefabricated regulatory units that install themselves into a host genome, which then recycles them to carry out entirely new functions like facilitating maternal-fetal communication" Lynch said.

Robert LeClerc and Gemma May from Yale also contributed to the research.

The work was funded by the John Templeton Foundation.

Story Source:

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1. Vincent J Lynch, Robert D Leclerc, Gemma May, Günter P Wagner. **Transposon-mediated rewiring of gene regulatory networks contributed to the evolution of pregnancy in mammals**. *Nature Genetics*, 2011; DOI: 10.1038/ng.917

http://www.sciencedaily.com/releases/2011/09/110925185434.htm

Why the warming climate makes animals smaller

- 14:57 23 September 2011 by **Michael Marshall**

Heat shrink *(Image: Image Quest 3d/NHPA)*

Honey, we shrank the copepods. These tiny marine animals offer a clue to why a warming climate makes animals smaller.

It is well established that cold-blooded species get smaller as the climate heats up, says Andrew Hirst of Queen Mary, University of London. Experiments show that, on average, 1 °C of warming reduces their adult body mass by 2.5 per cent. The mystery is why.

To find out, Hirst pulled together data on 15 species of copepod that swim in the open sea, focusing on how they grew at different temperatures. As temperatures rose, the copepods got heavier faster. Hirst thinks that's because physiological reactions accelerate at warmer temperatures, allowing the copepods to bulk up faster.

Growing up faster

But they also matured to adulthood faster, so their rapid growth ground to a halt at a young age. The overall effect was such that the warmer copepods wound up smaller.

It's not clear why temperature has such a strong effect on the way these organisms mature, but Hirst suspects evolution favours organisms that are flexible in how fast they mature to adulthood. In a competitive environment, this increases the odds that individuals will reproduce before they are killed.

The idea that growth and maturation respond differently to temperature has been around for a while, but no one has tested it across a range of species before, says Tim Coulson of Imperial College London.

He says changes in the size of species could prove critical in that such changes will affect what food animals can eat and what can prey on them in turn. "If you start changing the copepods, you could cause all sorts of unpredictable knock-on effects in the ecosystem," he says.

Journal reference: *The American Naturalist*, in press

http://www.newscientist.com/article/dn20960-why-the-warming-climate-makes-animals-smaller.html

Climatic Fluctuations Drove Key Events in Human Evolution, Researchers Find

Arrowhead. Research at the University of Liverpool has found that periods of rapid fluctuation in temperature coincided with the emergence of the first distant relatives of human beings and the appearance and spread of stone tools. (Credit: © chas53 / Fotolia)

ScienceDaily (Sep. 26, 2011) — Research at the University of Liverpool has found that periods of rapid fluctuation in temperature coincided with the emergence of the first distant relatives of human beings and the appearance and spread of stone tools.

Dr Matt Grove from the School of Archaeology, Classics and Egyptology reconstructed likely responses of human ancestors to the climate of the past five million years using genetic modelling techniques. When results were mapped against the timeline of human evolution, Dr Grove found that key events coincided with periods of high variability in recorded temperatures.

Dr Grove said: "The study confirmed that a major human adaptive radiation -- a pattern whereby the number of coexisting species increases rapidly before crashing again to near previous levels -- coincided with an extended period of climatic fluctuation. Following the onset of high climatic variability around 2.7 million years ago a number of new species appear in the fossil record, with most disappearing by 1.5 million years ago. The first stone tools appear at around 2.6 million years ago, and doubtless assisted some of these species in responding to the rapidly changing climatic conditions.

"By 1.5 million years ago we are left with a single human ancestor -- *Homo erectus*. The key to the survival of *Homo erectus* appears to be its behavioural flexibility -- it is the most geographically widespread species of the period, and endures for over one and a half million years. Whilst other species may have specialized in environments that subsequently disappeared -- causing their extinction -- *Homo erectus* appears to have been a generalist, able to deal with many climatic and environmental contingencies."

Dr Grove's research is the first to explicitly model 'Variability Selection', an evolutionary process proposed by Professor Rick Potts in the late 1990s, and supports the pervasive influence of this process during human evolution. Variability selection suggests that evolution, when faced with rapid climatic fluctuation, should respond to the range of habitats encountered rather than to each individual habitat in turn; the timeline of variability selection established by Dr Grove suggests that Homo erectus could be a product of exactly this process.

Linking climatic fluctuation to the evolutionary process has implications for the current global climate change debate. Dr Grove said: "Though often discussed under the banner term of 'global warming', what we see in many areas of the world today is in fact an increased annual range of temperatures and conditions; this means in particular that third world human populations, many living in what are already marginal environments, will face ever more difficult situations. The current pattern of human-induced climate change is unlike anything we have seen before, and is disproportionately affecting areas whose inhabitants do not have the technology required to deal with it."

The research is published in The *Journal of Human Evolution* and The *Journal of Archaeological Science*.

Story Source:

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

Journal References:

1. Matt Grove. **Change and variability in Plio-Pleistocene climates: modelling the hominin response**. *Journal of Archaeological Science*, 2011; 38 (11): 3038 DOI: 10.1016/j.jas.2011.07.002
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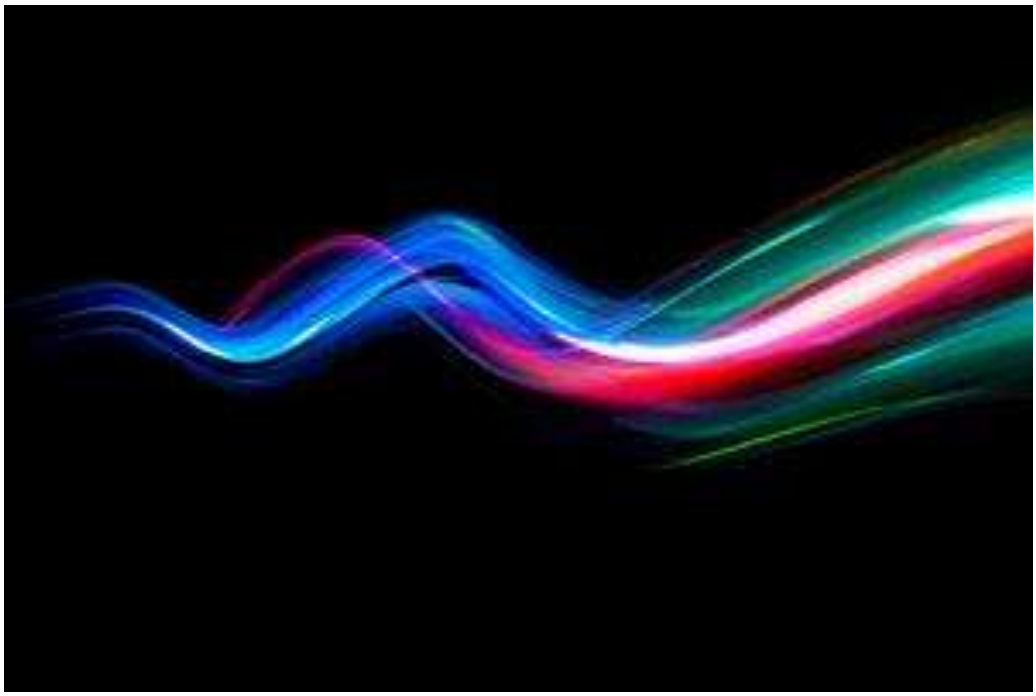
http://www.sciencedaily.com/releases/2011/09/110921115910.htm

Dimension-hop may allow neutrinos to cheat light speed

- 12:05 23 September 2011 by **Lisa Grossman**



(Image: John Rensten/Photographer's Choice/Getty)

A CERN experiment claims to have caught neutrinos breaking the universe's most fundamental speed limit. The ghostly subatomic particles seem to have zipped faster than light from the particle physics laboratory near Geneva, Switzerland, to a detector in Italy.

Fish that physics textbook back out of the wastebasket, though: the new result contradicts previous measurements of neutrino speed that were based on a supernova explosion. What's more, there is still room for error in the departure time of the supposed speedsters. And even if the result is correct, thanks to theories that posit extra dimensions, it does not necessarily mean that the speed of light has been beaten.

"If it's true, it's fantastic. It will rock the foundation of physics," says Stephen Parke of Fermilab in Batavia, Illinois. "But we still have to confirm it."

Neutrinos are nearly massless subatomic particles that are notoriously shy of interacting with other forms of matter. An experiment called OPERA (Oscillation Project with Emusion tRacking Apparatus) sent beams of neutrinos from a particle accelerator at CERN to a detector in the Gran Sasso cavern in Italy, 730 kilometres away.

The neutrinos arrived 60 nanoseconds sooner than they would have if they had been travelling at the speed of light, the team says.

Supernova contradiction

If real, the finding will force a rewrite of Einstein's theory of special relativity, one of the cornerstones of modern physics (and a theory whose predictions are incorporated into the design of the accelerators at CERN). "It's not reasonable," says theorist Marc Sher of the College of William and Mary in Williamsburg, Virginia.

One problem is that the CERN result busts the apparent speed limit of neutrinos seen when radiation from a supernova explosion reached Earth in February 1987.

Supernovae are exploding stars that are so bright they can briefly outshine their host galaxies. However, most of their energy actually streams out as neutrinos. Because neutrinos scarcely interact with matter, they should escape an exploding star almost immediately, while photons of light will take about 3 hours to get out. And in 1987, trillions of neutrinos arrived 3 hours before the dying star's light caught up, just as physicists would have expected.

The recent claim of a much higher neutrino speed just doesn't fit with this earlier measurement. "If neutrinos were that much faster than light, they would have arrived [from the supernova] five years sooner, which is crazy," says Sher. "They didn't. The supernova contradicts this [new finding] by huge factors."

Fuzzy departure

It's possible that the neutrinos that sped to the Italian mine were a different type of neutrino from the ones streaming from the supernova, or had a different energy. Either of those could explain the difference, Sher admits. "But it's quite unlikely."

A measurement error in the recent neutrino experiment could also explain the contradiction.

"In principle it's a very easy experiment: you know the distance between A and B, you know how long it takes the neutrinos to get there, so you can calculate their speed," Parke says. "However, things are more complicated than that. There are subtle effects that make it much more difficult."

For instance, although the detectors in Italy can pinpoint the neutrinos' time of arrival to within nanoseconds, it's less clear when they left the accelerator at CERN. The neutrinos are produced by slamming protons into a bar-shaped target, sparking a cascade of subatomic particles. If the neutrinos were produced at one end of the bar rather than the other, it could obscure their time of flight.

Sher also mentions a third option: that the measurement is correct. Some theories posit that there are extra, hidden dimensions beyond the familiar four (three of space, one of time). It's possible that the speedy neutrinos tunnel through these extra dimensions, reducing the distance they have to travel to get to the target. This would explain the measurement without requiring the speed of light to be broken.

Antonio Ereditato with the OPERA collaboration declined to comment until after a seminar to be held at CERN today at 4 pm Geneva time.

Extraordinary evidence wanted

In the meantime, Parke is reserving judgement until the result can be confirmed by other experiments such as the MINOS experiment at Fermilab or the T2K experiment in Japan.

"There are a number of experiments that are online or coming online that could be upgraded to do this measurement," he says. "These are the kind of things that we have to follow through, and make sure that our prejudices don't get in the way of discovering something truly fantastic."

In 2007, the MINOS experiment searched for faster-than-light neutrinos but didn't see anything statistically significant.

Although sceptical, he is willing to give their colleagues at OPERA the benefit of the doubt. "They certainly didn't do anything that's obviously stupid, or they would have caught that," Parke says.

"They're smart people, these are not crackpots," Sher agrees. "But as the old saying goes, extraordinary claims require extraordinary evidence. This is about as extraordinary as you get."

Reference: arxiv.org/abs/1109.4897

http://www.newscientist.com/article/dn20957-dimensionhop-may-allow-neutrinos-to-cheat-light-speed.html

Scientists Discover an Organizing Principle for Our Sense of Smell Based On Pleasantness

New findings reveal a correlation between the response of certain nerves to particular scents and the pleasantness of those scents. (Credit: © Nejron Photo / Fotolia)

ScienceDaily (Sep. 25, 2011) — The fact that certain smells cause us pleasure or disgust would seem to be a matter of personal taste. But new research at the Weizmann Institute shows that odors can be rated on a scale of pleasantness, and this turns out to be an organizing principle for the way we experience smell. The findings, which appeared September 26 in *Nature Neuroscience*, reveal a correlation between the response of certain nerves to particular scents and the pleasantness of those scents. Based on this correlation, the researchers could tell by measuring the nerve responses whether a subject found a smell pleasant or unpleasant.

Our various sensory organs are have evolved patterns of organization that reflect the type of input they receive. Thus the receptors in the retina, in the back of the eye, are arranged spatially for efficiently mapping out visual coordinates. The structure of the inner ear, on the other hand, is set up according to a tonal scale. But the organizational principle for our sense of smell has remained a mystery: Scientists have not even been sure if there is a scale that determines the organization of our smell organ, much less how the arrangement of smell receptors on the membranes in our nasal passages might reflect such a scale.

A team headed by Prof. Noam Sobel of the Weizmann Institute's Neurobiology Department set out to search for the principle of organization for smell. Hints that the answer could be tied to pleasantness had been seen in research labs around the world, including that of Sobel, who had previously found a connection between the chemical structure of an odor molecule and its place on a pleasantness scale. Sobel and his team thought that smell receptors in the nose -- of which there are some 400 subtypes -- could be arranged on the nasal membrane according to this scale. This hypothesis goes against the conventional view, which claims that the various smell receptors are mixed -- distributed evenly, but randomly, around the membrane.

In the experiment, the researchers inserted electrodes into the nasal passages of volunteers and measured the nerves' responses to different smells in various sites. Each measurement actually captured the response of thousands of smell receptors, as these are densely packed on the membrane. The scientists found that the strength of the nerve signal varies from place to place on the membrane. It appeared that the receptors are not evenly distributed, but rather, that they are grouped into distinct sites, each engaging most strongly with a particular type of scent. Further investigation showed that the intensity of a reaction was linked to the odor's place on the pleasantness scale. A site where the nerves reacted strongly to a certain agreeable scent also showed strong reactions to other pleasing smells and vice versa: The nerves in an area with a high response to an unpleasant odor reacted similarly to other disagreeable smells. The implication is that a pleasantness scale is, indeed, an organizing principle for our smell organ.

But does our sense of smell really work according to this simple principle? Natural odors are composed of a large number of molecules -- roses, for instance, release 172 different odor molecules. Nonetheless, says Sobel, the most dominant of those determine which sites on the membrane will react the most strongly, while the other substances make secondary contributions to the scent.

'We uncovered a clear correlation between the pattern of nerve reaction to various smells and the pleasantness of those smells. As in sight and hearing, the receptors for our sense of smell are spatially organized in a way that reflects the nature of the sensory experience,' says Sobel. In addition, the findings confirm the idea that our experience of smells as nice or nasty is hardwired into our physiology, and not purely the result of individual preference. Sobel doesn't discount the idea that individuals may experience smells differently. He theorizes that cultural context and personal experience may cause a certain amount of reorganization in smell perception over a person's lifetime.

Story Source:

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

Journal Reference:

1. Hadas Lapid, Sagit Shushan, Anton Plotkin, Hillary Voet, Yehudah Roth, Thomas Hummel, Elad Schneidman, Noam Sobel. **Neural activity at the human olfactory epithelium reflects olfactory perception**. *Nature Neuroscience*, 2011; DOI: 10.1038/nn.2926

http://www.sciencedaily.com/releases/2011/09/110926104624.htm

Why Metaphysics Is Always Bizarre

Bizarre views are a hazard endemic to metaphysics. The metaphysician starts, seemingly, with some highly plausible initial commitments or commonsense intuitions -- that there is a prime number between 2 and 5, that I could have had eggs for breakfast, that squeezing the clay statue would destroy the statue but not the lump of clay -- thinks long and hard about what they imply, and then ends up positing a realm of abstract Platonic entities, or the real existence of an infinite number of possible worlds, or a huge population of spatiotemporally coincident things on her mantelpiece. I believe there is not a single detailed exploration of fundamental issues of metaphysics that does not, by the end, entangle its author in seeming absurdities (sometimes advertised as "surprising conclusions"). Rejection of these absurdities then becomes the commonsense starting point of a new round of metaphysics, by other philosophers, which in turn generates a complementary bestiary of metaphysical strangeness. Thus are philosophers happily employed.

I see three possible explanations of why philosophical metaphysics is never thoroughly commonsensical.

One is that a thoroughly commonsensical metaphysics wouldn't sell. It would be too boring. A famous philosopher can't say only obvious things. The problem with this explanation is that there should be at least a small market for a thoroughly commonsensical philosophy. Common sense might not be quite as fun as Nietzsche's eternal recurrence or Leibniz's windowless monads or Hegel's world spirit, but a commonsensical metaphysics ought to serve at least as a foil; it oughtn't be so downmarket as to be entirely invisible. In the 18th century, Thomas Reid helped found the Scottish school of "common sense" philosophy, and today he is the best known representative of that school -- so one might naturally wonder if Reid's metaphysics is thoroughly commonsensical. It's not. See, for example, his thoughts on the immaterial souls of vegetables. Nor is G.E. Moore's, when he develops his positive views in detail, despite his famous "Defence of Common Sense". See, for example, his treatment of sense data.

Another possible explanation is that metaphysics is incredibly hard. There is a thoroughly commonsensical metaphysics out there to be had; we simply haven't pieced it together yet. Maybe someday someone will finally bring it all together, top to bottom, with no serious violence to common sense at any point in the system. I fear this is wishful thinking against the evidence. (In a future post I hope to argue the point in more detail for the metaphysics of mind.)

A third explanation of the bizarreness of metaphysics is this: Common sense is incoherent in matters of metaphysics. Detailed examination of the consequences of our commonsense opinions inevitably leads to contradictions. To develop a coherent metaphysics in detail thus necessarily involves rejecting some aspects of common sense. Although ordinary common sense serves us fairly well in negotiating our everyday social and physical environments, it has not proven a reliable guide in cosmology or microphysics or neuroscience or evolutionary biology or probability theory or structural engineering or medicine or macroeconomics or topology. If metaphysics more closely resembles items in the second class than in the first, as it seems to, we might justifiably be suspicious of the dependability of common sense as a guide to metaphysics. Undependability does not imply incoherence, but it does seem a natural next step in this particular case, especially since it would generate a tidy explanation of the historical fact that detailed metaphysical systems are never thoroughly commonsensical.

Thus, I am endorsing the incoherence of common sense in matters metaphysical as an empirical hypothesis, justified as the best explanation of an empirically observed pattern in the history of philosophy.

Posted by Eric Schwitzgebel at 3:49 PM

http://schwitzsplinters.blogspot.com/2011/09/why-metaphysics-is-always-bizarre.html

'Superfast' Muscles Responsible for Bat Echolocation

Daubenton's bat about to catch prey. (Credit: Lasse Jakobsen & Coen Elemans)

ScienceDaily (Sep. 30, 2011) — As nocturnal animals, bats rely echolocation to navigate and hunt prey. By bouncing sound waves off objects, including the bugs that are their main diet, bats can produce an accurate representation of their environment in total darkness. Now, researchers at the University of Southern Denmark and the University of Pennsylvania have shown that this amazing ability is enabled by a physical trait never before seen in mammals: so-called "superfast" muscles.

The work was conducted by Coen Elemans, John Ratcliffe and Lasse Jakobsen of Denmark, along with Andrew Mead, a graduate student in the Department of Biology in Penn's School of Arts and Science.

Their findings will appear in the journal *Science.*

Superfast muscles are capable of contraction about 100 times faster than typical body muscles and as much as 20 times faster than the fastest human muscles, those that control eye movement. Mead, who studies muscle physiology, and Elemans, who studies neuroscience and biomechanics, had previously collaborated in studying how superfast muscles help birds sing.

"Superfast muscles were previously known only from the sound-producing organs of rattlesnakes, birds and several fish," Elemans said. "Now we have discovered them in mammals for the first time, suggesting that these muscles -- once thought extraordinary -- are more common than previously believed."

With vision, animals receive a more-or-less continuous stream of information about the world. With echolocation, however, bats only get a snapshot of their environment with each call and echo, requiring them to make rapid successions of calls. When hunting a flying insect that can quickly move in any direction, bats

need the most rapid updates on their prey's position in the instant before the catch. At this critical point, bats produce what is known as the "terminal buzz," where they make as many as 190 calls per second.

"Bat researchers assumed that the muscles that control this behavior must be pretty fast, but there was no understanding of how they worked," Mead said. "Research on superfast muscles is just a world apart from what they do. This study represents many worlds coming together: the muscle world, that bio-acoustics and echolocation world and the bat behavioral world."

The researchers tested the performance of the bats' vocal muscles by attaching one between a motor and a force sensor and electrically stimulating it to flex. When the motor was stationary, a single electric pulse allowed the researchers to measure the time that bat muscle took to twitch, or to contract and relax.

"The twitch gives us a sense of the time it takes for a muscle cell to go though all the steps, all the chemical reactions, necessary exert force and to relax again," Mead said. "The faster the muscle, the shorter the twitch. These muscles could go through all the motions in less than a hundredth of a second."

To approximate how much work the muscle was doing within the bat, however, the researchers had to change the length of the muscle while it was contracting. When the motor was on, it lengthened and shortened the muscle at a controllable rate. While the muscle was being stretched, the researchers stimulated the muscle to contract, so they could see if the muscle pulled on the motor harder than the motor pulled on the muscle.

The test to see if the muscle was truly of the superfast type involved increasing the speed of the motor to more than a 100 oscillations per second.

"You're always limited to how many twitches you can do in a given period of time," Mead said. "If you keep on increasing the frequency, doing twitch after twitch, you get to the point where the twitches begin to build on top of each other and the muscle doesn't fully turn off. We went to the highest cycling frequency where we still had evidence that the muscle was turning on and off. "

The researchers also did an experiment in which bats hunted insects in a chamber wired with microphones in order to determine the theoretical maximum frequency for a buzz without overlapping echoes, which could confuse the bat.

"We determined the power the muscles can deliver, much like how you measure a car's performance," Denmark's Elemans said. "We were surprised to see that bats have the superfast muscle type and can power movements up to 190 times per second, but also that it is actually the muscles that limit the maximum call rate during the buzz."

"You can think of it like a car engine," Mead said. "It can be tuned to be efficient, or tuned to be powerful depending on what you want it to do. It turns out that bats trade off a lot of force to be able to get these rapid oscillations. In a way it's like an engine that's been tuned for extremely high RPM."

Mead and Elemans plan further study of superfast muscles from a molecular and genetic perspective.

"With more and more genomes being sequenced, including one species of bat, and one from a bird we've studied,' Mead said, "we have some powerful tools to start pick apart whether or not similar genes are involved in various important roles."

The work was supported by the Danish Research Council, Carlsberg Foundation, Grass Foundation, Company of Biologists and Oticon Foundation.

Story Source:

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Journal Reference:

1. C. P. H. Elemans, A. F. Mead, L. Jakobsen, J. M. Ratcliffe. **Superfast Muscles Set Maximum Call Rate in Echolocating Bats**. *Science*, 2011; 333 (6051): 1885 DOI: 10.1126/science.1207309

http://www.sciencedaily.com/releases/2011/09/110929152102.htm

History That's Written in Beads as Well as in Words

By PATRICIA COHEN

Distressed by most historians' overwhelming preoccupation with the modern world, an unusual coalition of scholars is trying to stage an intellectual coup, urging their colleagues to look up from the relatively recent swirl of bloody conflicts, global financial exchanges and technological wonders and gaze further back, toward humanity's origins.

The up-close and personal accounts that have won professional praise and rewards in recent years are worthy, said Daniel Lord Smail, a medieval historian at Harvard, but he says the "microhistory" trend has stunted the ambition to think big.

"In the last two or three decades, historians have found it hard to think across large time spans," he contends; gone are the sweeping narratives of humanity's advance. The antidote to this "shallow history," he said, is "deep history," stretching back 50,000, 500,000, even 2.6 million years to the earliest humans. Recent advances in archaeological analysis, gene mapping and evolutionary ecology have led to an astonishing expansion in our knowledge of the distant past, despite the lack of written records, the historian's traditional sidearm.

Yet at the same time, historians and other humanities scholars have increasingly restricted their sights to the near present. Three out of four historians, for example, specialize in the post-industrial era or the 20th century, the American Historical Association reports.

After reviewing the roster of professorships, course offerings, dissertation topics and publications in recent decades, Mr. Smail and Andrew Shryock, a cultural anthropologist at the University of Michigan, concluded

that both of their disciplines rarely venture beyond the last 250 years. Most of the long march of human existence is being ignored, they complain.

To point the way toward what Mr. Smail calls the "new intellectual frontier," a small cadre of diverse collaborators in anthropology, archaeology, primatology, genetics and linguistics have spent the last two and half years working on a forthcoming book, "Deep History: The Architecture of Past and Present" (University of California Press) that serves as a kind of manifesto for their cause.

As the authors explain, deep history emphasizes trends and processes rather than individuals and events, paying more attention to kinship, genealogy and developing traditions, like hospitality, for example. What historians and other humanists do best is tell stories, Mr. Shryock said. They can help lift the fog that has surrounded our ancestors and bring them to life. In these ancient, shadowy figures, people today can recognize the family ties, food, religious fervor, sexual passions, conflicts and artistic impulses that shape their own lives.

Dipesh Chakrabarty, a historian at the University of Chicago, who has seen the book, said that since historians are not those who do the radiocarbon dating or the genetic analysis, they won't be making discoveries. Rather, they have a role "in retelling the human story," he said, adding, "They bring to the table a sense of contingency in human affairs," of the unpredictable mix of individual actions and social and environmental forces.

Mr. Chakrabarty added that deep history was appealing because it enabled you to take a step back. "The more contemporary history gets, the more politicized it gets," he said.

Some in the field challenge the contention that historians have abandoned the long view. Anthony Grafton, president of the American Historical Association, appreciates that deep history can encourage scholars to look further back. But he disputes the claim that comprehensive histories are in short supply.

"I think that whole thing about the grand narrative is a cliché that gets thrown around a lot," he said.

The proponents of "deep history" seek to upend the discipline's most precious precept and method: the reliance on the written record of the past. "No documents, no history," a manual of historical study commanded in 1898. Everything that came before is shunted into the category of prehistory.

The 10 authors of "Deep History" want to eliminate prehistory as a category and unchain historians from the word. "We want to change what counts as evidence," Mr. Shryock said. "There are all kinds of materials that leave traces and can serve as evidence," he added, naming fossils, tools, household items, pictures, structures, ecological changes and genetic variations.

As an example, Mr. Shryock and Mr. Smail point to an object as common and unremarkable as the bead. In a new paper submitted to The American Historical Review that they said they hoped would stir debate, they write that archaeologists now know that an explosion of bead making, using shells and pearl teeth from red deer, occurred in the Mediterranean region about 43,000 years ago. While Neanderthals did not create beads, our human ancestors did, using them to extend social relationships, signal status or loyalties, adorn the body and exchange for goods, as an early form of currency.

Connect the dots, and beads can also be seen as the precursors of mass-produced items.

"Relative to population size, after all, shell beads were perhaps being produced in the Upper Paleolithic at the rate iPhones are being manufactured today," they declare, adding that gold beads — "expensive copies of

inexpensive objects" — are linked with the emergence of different classes, "a strange inversion of the pattern of luxury knockoffs."

The proliferation of beads, they argue, was used to form political alliances and economic networks that were, in turn, reinforced by the exchange of beads and their offspring, coins. Later, beads allowed ancient people to transform food surpluses, created by shifts in production, into commerce and political power.

The authors continue the tale to the present, maintaining that credit cards, bank notes, gold coins and shell bead necklaces all share a single genealogy. "You can't fully understand how money functions today without beads," Mr. Shryock said.

The same sort of analysis can be applied in other realms. Climate change did not begin with the industrial revolution, Mary C. Stiner, an archaeology professor at the University of Arizona, and Gillian Feeley-Harnik, an anthropologist at the University of Michigan, argue in "Deep History: The Architecture of Past and Present," which is due out in November.

Though the scale is of a different magnitude, human beings have left their footprints on the environment for 50,000 years through hunting, fishing, domesticating animals and agricultural burn-offs. American Indians in the Eastern woodlands managed their environment, Mr. Smail added, cutting down trees to create a habitat for deer.

The desire to take the long view is not new. Nineteenth-century thinkers like Auguste Comte, Karl Marx and Herbert Spencer chronicled humanity's fortunes with great ambition and scarce hard evidence. In the 1920s and '30s, French historians of the Annales School combined history, geography and sociology to explore the evolution of civilizations. And for the last 20 years or so, the historians David Christian and Fred Spier have championed big history, urging their colleagues to begin their once-upon-a-time accounts billions of years ago, with the big bang.

With the rise of postmodernism in the academy in the 1970s and '80s, scholars tended to retreat from grand narratives, which were criticized for presenting European domination as both inevitable and desirable. Deep history advocates say they want to resuscitate the scale without the bias.

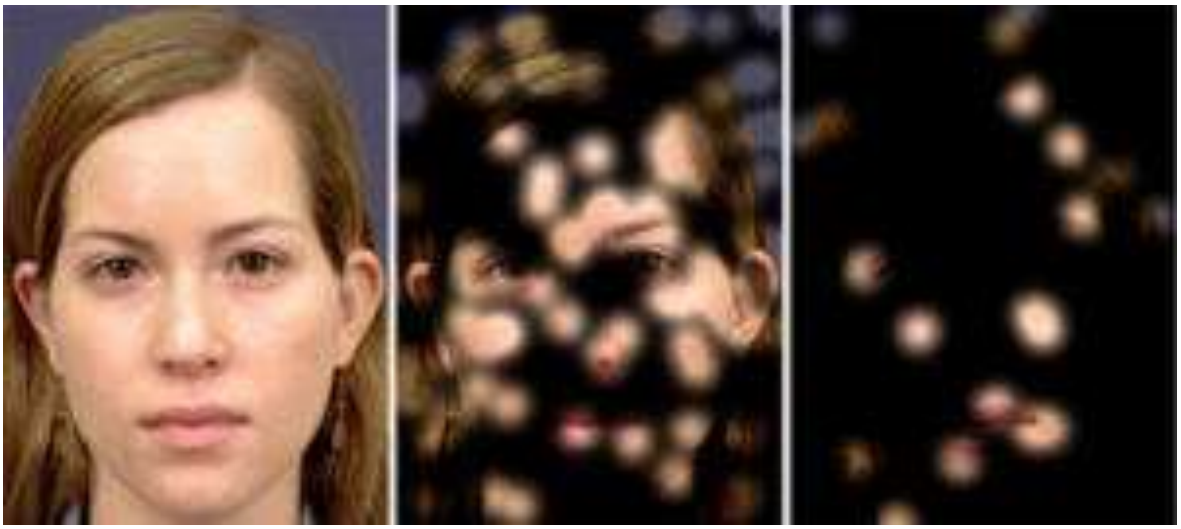
William Cronon, an environmental historian at the University of Wisconsin in Madison, said he was sympathetic to the aims of deep history and that it meshed well with his own work, but "what matters in the end are what questions you ask."

You can say, he offered, that Lee Harvey Oswald's assassination of President John F. Kennedy depended on the discovery of iron, but so what? "The questions shape the evidence," he said.

Advocates like Mr. Smail and Mr. Shryock don't disagree; they just want to provoke different questions. Some historians and other humanists treat the modern era as if it suddenly popped out of a chicken, "like an unfertilized egg," Mr. Smail said. "Historians need to develop the habit of looking backward," he said, " to see how their own period is in a dialogue with what came before."

http://www.nytimes.com/2011/09/27/arts/deep-history-takes-humanity-back-to-its-origins.html?_r=1

Neuroscientists Record Novel Responses to Faces from Single Neurons in Humans



This figure shows the kind of stimuli used in the study: whole faces (left) and only partly revealed faces. According to the researchers, the surprising finding was that although neurons respond most strongly to seeing the whole face, they actually respond much less to the middle panel than to the far right panel, even though the middle panel is more similar to the whole face. (Credit: Ralph Adolphs, California Institute of Technology)

ScienceDaily (Sep. 30, 2011) — Responding to faces is a critical tool for social interactions between humans. Without the ability to read faces and their expressions, it would be hard to tell friends from strangers upon first glance, let alone a sad person from a happy one. Now, neuroscientists from the California Institute of Technology (Caltech), with the help of collaborators at Huntington Memorial Hospital in Pasadena and Cedars-Sinai Medical Center in Los Angeles, have discovered a novel response to human faces by looking at recordings from brain cells in neurosurgical patients.

The finding, described in the journal *Current Biology*, provides the first description of neurons that respond strongly when the patient sees an entire face, but respond much less to a face in which only a very small region has been erased.

"The finding really surprised us," says Ueli Rutishauser, first author on the paper, a former postdoctoral fellow at Caltech, and now a visitor in the Division of Biology. "Here you have neurons that respond well to seeing pictures of whole faces, but when you show them only parts of faces, they actually respond less and less the more of the face you show. That just seems counterintuitive."

The neurons are located in a brain region called the amygdala, which has long been known to be important for the processing of emotions. However, the study results strengthen a growing belief among researchers that the amygdala has also a more general role in the processing of, and learning about, social stimuli such as faces.

Other researchers have described the amygdala's neuronal response to faces before, but this dramatic selectivity -- which requires the face to be whole in order to elicit a response -- is a new insight.

"Our interpretation of this initially puzzling effect is that the brain cares about representing the entire face, and needs to be highly sensitive to anything wrong with the face, like a part missing," explains Ralph Adolphs, senior author on the study and Bren Professor of Psychology and Neuroscience and professor of

biology at Caltech. "This is probably an important mechanism to ensure that we do not mistake one person for another and to help us keep track of many individuals."

The team recorded brain-cell responses in human participants who were awaiting surgery for drug-resistant epileptic seizures. As part of the preparation for surgery, the patients had electrodes implanted in their medial temporal lobes, the area of the brain where the amygdala is located. By using special clinical electrodes that have very small wires inserted, the researchers were able to observe the firings of individual neurons as participants looked at images of whole faces and partially revealed faces. The voluntary participants provided the researchers with a unique and very rare opportunity to measure responses from single neurons through the implanted depth electrodes, says Rutishauser.

"This is really a dream collaboration for basic research scientists," he says. "At Caltech, we are very fortunate to have several nearby hospitals at which the neurosurgeons are interested in such collaborative medical research."

The team plans to continue their studies by looking at how the same neurons respond to emotional stimuli. This future work, combined with the present study results, could be highly valuable for understanding a variety of psychiatric diseases in which this region of the brain is thought to function abnormally, such as mood disorders and autism.

Story Source:

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

Journal Reference:

1. Ueli Rutishauser, Oana Tudusciuc, Dirk Neumann, Adam N. Mamelak, A. Christopher Heller, Ian B. Ross, Linda Philpott, William W. Sutherling, Ralph Adolphs. **Single-Unit Responses Selective for Whole Faces in the Human Amygdala**. *Current Biology*, 29 September 2011 DOI: 10.1016/j.cub.2011.08.035

http://www.sciencedaily.com/releases/2011/09/110929122753.htm

Revealing the Layers of Cuba's Architecture

By EVE M. KAHN

The Cuban government may be sending a subtle message to potential American tourists that preserved architecture and antiques collections are viewable throughout the island. Four new coffee table books on the subject have been published, and the authors report few restrictions on what they could document.

The historian Michael Connors and the photographer Brent Winebrenner did get shooed away from one 1840s palacio in Havana. "It is ironically the headquarters of the Institute of the History of the Communist Movement and the Socialist Revolution, and therefore strictly off limits to foreigners," Mr. Connors writes in "The Splendor of Cuba: 450 Years of Architecture and Interiors" (Rizzoli).

The books show that buildings in government hands, at least, have held up well, and the imprints of American and European designers and clients remain detectable. "Great Houses of Havana: A Century of Cuban Style" (the Monacelli Press), by the architect Hermes Mallea, and "Inside Havana" (Taschen), by the historian Julio César Pérez Hernández, both devote chapters to the American tobacco tycoon Mark Pollack's Renaissance stone house, completed around 1930. Visiting dignitaries now spend the night amid its murals of putti and gilded mosaics of seaweed and palm trees.

Conditions there have deteriorated somewhat since Pollack's day. In the two-story living room, Mr. Mallea writes, "a bronze grille is all that remains of the original pipe organ."

Mr. Connors's book shows Louis Comfort Tiffany floral lamps set on end tables at a countess's 1920s house, furnished by the Parisian firm Maison Jansen. (The property was turned into a museum in 1964, soon after the countess fled the Communist takeover.) The Taschen and Monacelli books depict an octagonal light fixture by the French glassmaker René Lalique in the sunroom of a 1920s villa, now the House of Friendship.

Cubans without government backing, however, can barely maintain their buildings. "Paint has relentlessly chipped off walls and haphazardly peeled from portraits, ghostly rectangles of lighter color glimmer on walls where paintings once had hung, beach chairs with webbed seats and backs stand in for fine-turned furniture," the critic Vicki Goldberg writes in "Havana" (Prestel), a collection of Michael Eastman's photos of moldering homes and streetscapes.

Mr. Eastman focused on clotheslines sagging over ornate iron balconies and decrepit plywood chairs gathered around glossy lacquered pianos. "Eastman says the owners sacrifice to stay in their ancestral homes," Ms. Goldberg writes.

SERIOUS AMERICANA

Jane Katcher has spent more than $100,000 producing two sumptuous books about her American folk art collection. When the volumes were arrayed on a table during a recent interview at a cafe near her Manhattan apartment, a waitress hovered and said: "Beautiful books! So great!"

Dr. Katcher, a retired pediatric radiologist, said she had mixed feelings about attracting attention through the books (both distributed by Yale University Press). "Expressions of Innocence and Eloquence: Selections From the Jane Katcher Collection of Americana," Volume I, came out in 2006, and Volume II has been released to coincide with an exhibition, "Inspired Traditions: Selections From the Jane Katcher Collection of Americana," which opens on Saturday at the Fenimore Art Museum in Cooperstown, N.Y.

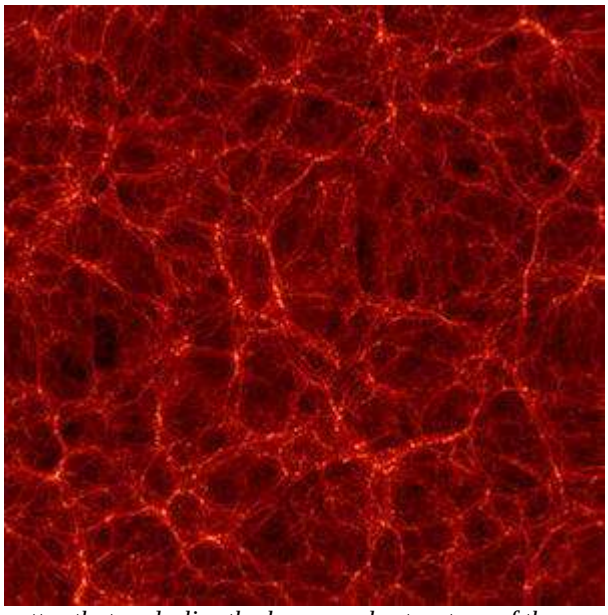
"People can call it great indulgence, but I think it has pushed scholarship forward," she said. She brought in about 20 scholars to write the essays, including Paul S. D'Ambrosio, the president of the Fenimore museum, and the Americana dealers David A. Schorsch and Eileen M. Smiles, who advise Dr. Katcher on her purchases. Her interests include weathervanes, clocks, quilts, high school award certificates and albums with keepsakes made of human hair.

The topics in the second volume range from Wilkinson Limner, a Massachusetts painter who may have served prison time for counterfeiting, to Amy Cohn, a storekeeper in Nevada who dressed in American Indian beadwork to help market willow baskets by the Washoe weaver Louisa Keyser. Dr. Katcher started collecting in the 1970s, as a young doctor dealing with children sometimes facing a dire prognosis. Folk art's cheeriness provided "relief to a very serious job," she said. Her husband, Gerald Katcher, a banker, patiently supports her hobby. "I would call him 'the enabler,' " she said.

Based on the books' detailed descriptions of provenances, nosy readers can calculate what Mr. Schorsch and Ms. Smiles have spent at auction on Dr. Katcher's behalf. Among the top recent lots is the cover image on the second volume: a 1740s portrait of a bride in Kingston, N.Y., which sold for $1.1 million at Keno Auctions last year in Stamford, Conn.

http://www.nytimes.com/2011/09/30/arts/design/new-books-on-cuba-and-an-americana-collection.html?ref=design

Scientists Release Most Accurate Simulation of the Universe to Date



The Bolshoi simulation reveals a cosmic web of dark matter that underlies the large-scale structure of the universe and, through its gravitational effects on ordinary matter, drives the formation of galaxies and galaxy clusters. The image is a slice of the entire simulation, 1 billion light-years across and about 30 million light-years thick. (Credit: Stefan Gottlober (AIP))

ScienceDaily (Sep. 30, 2011) — The Bolshoi supercomputer simulation, the most accurate and detailed large cosmological simulation run to date, gives physicists and astronomers a powerful new tool for understanding such cosmic mysteries as galaxy formation, dark matter, and dark energy.

The simulation traces the evolution of the large-scale structure of the universe, including the evolution and distribution of the dark matter halos in which galaxies coalesced and grew. Initial studies show good agreement between the simulation's predictions and astronomers' observations.

"In one sense, you might think the initial results are a little boring, because they basically show that our standard cosmological model works," said Joel Primack, distinguished professor of physics at the University of California, Santa Cruz. "What's exciting is that we now have this highly accurate simulation that will provide the basis for lots of important new studies in the months and years to come."

Primack and Anatoly Klypin, professor of astronomy at New Mexico State University, lead the team that produced the Bolshoi simulation. Klypin wrote the computer code for the simulation, which was run on the Pleiades supercomputer at NASA Ames Research Center. "These huge cosmological simulations are essential for interpreting the results of ongoing astronomical observations and for planning the new large surveys of the universe that are expected to help determine the nature of the mysterious dark energy," Klypin said.

Primack, who directs the University of California High-Performance Astrocomputing Center (UC-HIPACC), said the initial release of data from the Bolshoi simulation began in early September. "We've released a lot of

the data so that other astrophysicists can start to use it," he said. "So far it's less than one percent of the actual output, because the total output is so huge, but there will be additional releases in the future."

The previous benchmark for large-scale cosmological simulations, known as the Millennium Run, has been the basis for some 400 papers since 2005. But the fundamental parameters used as the input for the Millennium Run are now known to be inaccurate. Produced by the Virgo Consortium of mostly European scientists, the Millennium simulation used cosmological parameters based on the first release of data from NASA's Wilkinson Microwave Anisotropy Probe (WMAP). WMAP provided a detailed map of subtle variations in the cosmic microwave background radiation, the primordial radiation left over from the Big Bang. But the initial WMAP1 parameters have been superseded by subsequent releases: WMAP5 (five-year results released in 2008) and WMAP7 (seven-year results released in 2010).

The Bolshoi simulation is based on WMAP5 parameters, which are consistent with the later WMAP7 results. "The WMAP1 cosmological parameters on which the Millennium simulation is based are now known to be wrong," Primack said. "Moreover, advances in supercomputer technology allow us to do a much better simulation with higher resolution by almost an order of magnitude. So I expect the Bolshoi simulation will have a big impact on the field."

The standard explanation for how the universe evolved after the Big Bang is known as the Lambda Cold Dark Matter model, and it is the theoretical basis for the Bolshoi simulation. According to this model, gravity acted initially on slight density fluctuations present shortly after the Big Bang to pull together the first clumps of dark matter. These grew into larger and larger clumps through the hierarchical merging of smaller progenitors. Although the nature of dark matter remains a mystery, it accounts for about 82 percent of the matter in the universe. As a result, the evolution of structure in the universe has been driven by the gravitational interactions of dark matter. The ordinary matter that forms stars and planets has fallen into the "gravitational wells" created by clumps of dark matter, giving rise to galaxies in the centers of dark matter halos.

A principal purpose of the Bolshoi simulation is to compute and model the evolution of dark matter halos. The characteristics of the halos and subhalos in the Bolshoi simulation are presented in a paper that has been accepted for publication in the Astrophysical Journal and is now available online. The authors are Klypin, NMSU graduate student Sebastian Trujillo-Gomez, and Primack.

A second paper, also accepted for publication in the Astrophysical Journal and available online, presents the abundance and properties of galaxies predicted by the Bolshoi simulation of dark matter. The authors are Klypin, Trujillo-Gomez, Primack, and UCSC postdoctoral researcher Aaron Romanowsky. A comparison of the Bolshoi predictions with galaxy observations from the Sloan Digital Sky Survey showed very good agreement, according to Primack.

The Bolshoi simulation focused on a representative section of the universe, computing the evolution of a cubic volume measuring about one billion light-years on a side and following the interactions of 8.6 billion particles of dark matter. It took 6 million CPU-hours to run the full computation on the Pleiades supercomputer, recently ranked as the seventh fastest supercomputer in the world.

A variant of the Bolshoi simulation, known as BigBolshoi or MultiDark, was run on the same supercomputer with the same number of particles, but this time in a volume 64 times larger. BigBolshoi was run to predict the properties and distribution of galaxy clusters and other very large structures in the universe, as well as to help with dark energy projects such as the Baryon Oscillation Spectroscopic Survey (BOSS).

Another variant, called MiniBolshoi, is currently being run on the Pleiades supercomputer. MiniBolshoi focuses on a smaller portion of the universe and provides even higher resolution than Bolshoi. The Bolshoi simulation and its two variants will be made publicly available to astrophysical researchers worldwide in

phases via the MultiDark Database, hosted by the Potsdam Astrophysics Institute in Germany and supported by grants from Spain and Germany.

Primack, Klypin, and their collaborators are continuing to analyze the results of the Bolshoi simulation and submit papers for publication. Among their findings are results showing that the simulation correctly predicts the number of galaxies as bright as the Milky Way that have satellite galaxies as bright as the Milky Way's major satellites, the Large and Small Magellanic Clouds.

"A lot more papers are on the way," Primack said.

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http://www.sciencedaily.com/releases/2011/09/110929144645.htm

Putting Names to the Greats of Indian Art

By ROBERTA SMITH

Art historians rarely rest, and the world is generally a better place for their exertions. Scholars of the great painting traditions of India, for example, have taken knowledge of their subject to new levels in the past few decades, with their assiduous combing of documents, deciphering of inscriptions and scrutinizing of artworks.

Their immediate aim has been to name the names of Indian artists and identify their creations, pinning down as never before who did what, where and when. Their motive has been to dispel the long-held view, especially in the West, that these often small, transcendent works were made by unlauded artisans toiling away in monasteries and imperial workshops.

" 'Wonder of the Age': Master Painters of India, 1100-1900" at the Metropolitan Museum of Art is in effect an epic and immersive progress report on this research. Simultaneously a scholarly turning point, stylistic chronology and pictorial feast, it has been organized by John Guy, a curator of Asian art at the Met, and Jorrit Britschgi, curator of Indian painting at the Museum Rietberg in Zurich, where it was seen last summer. In the catalog introduction the curators cite more than 30 art historians from Europe, the United States and India on whose scholarship their own work builds.

The exhibition outlines the rich history of painting culture in India, beginning with an illuminated manuscript executed on palm leaves in a Buddhist monastery in the 12th century and concluding with two startlingly large paintings inspired by European models and influenced by photography, which were made for the Maharana of Udaipur around 1890 and have never before been allowed out of his palace (now a municipal museum).

Nearly 200 works in six galleries explore the elaborate style wars between the raw vigor and flat color blocks of the indigenous Rajput (Hindu) court manner and the finely calibrated naturalism and delicate patterns

imported by the conquering Mughals of Central Asia. Repeatedly fusing, breaking apart and fusing again, these styles percolated throughout northern and central India as the Mughals expanded their dominance over Rajput courts, especially in the late 16th and 17th centuries.

While most exhibitions of Indian paintings include only a few examples whose creators are known by name, this one concentrates almost exclusively on works that are known or thought to be by some 40 individuals. In some cases the actual names are lost to history, but even then the artists are more individuated than before, awarded the nom d'art of "Master" of a specific illuminated manuscript, technique or court.

We encounter families of artists, some of whom worked for successive generations of emperors, most notably the brilliantly cosmopolitan Akbar the Great, who took over the first Mughal court at Delhi in 1556, and his son Jahangir and grandson Shah Jahan, all passionate patrons of painting. Toward the end of the show, in the late 18th and early 19th centuries, when the Mughal courts were in disarray, we see the emergence of Rajput family workshops that catered to multiple patrons, both Indian and European.

The show is a somewhat wild ride down one of the three longest and greatest rivers of world painting (the other two being Chinese and European). Sometimes, as in the opening gallery, you might almost be shooting rapids, so quickly do the elements of the Rajput vocabulary accrue from one Buddhist, Hindu or Jainist manuscript to the next.

And then, in the same gallery, we suddenly reach Akbar's court, with a delicately realistic image of the young soon-to-be emperor out hawking with noblemen, crossing a vertiginous slope face of dust-colored rock; bright color is allotted only to the hunters' clothing and steeds. It is attributed to Abd al-Samad, a Persian artist who oversaw Akbar's extensive workshop, which attracted artists from across the subcontinent. On the opposite wall is refinement of a more familiar sort, in a set of images by Basawan, a Hindu recruit who took full advantage of the European engravings and paintings Akbar collected, but who had also learned a thing or two about fantastical Persian rock formations.

In other words, this show is not a coherent succession of gemlike Indian-painting bonbons. Things may cohere wall by wall, but turn almost any corner, or enter a new gallery, and you're waylaid by a new personality or style or treatment of space — especially space. One of the basic lessons of this extraordinary journey is how much of the power of Indian painting on both sides of the stylistic divide resides in carefully structured tensions between surface and depth, compressed onto relatively small rectangles where no area is left unattended.

The artists of the court of Akbar and his successors dominate the second gallery, mixing Persian and Mughal strains with European notions of perspective — both linear and atmospheric — and portraiture. An image of a Sufi sage, a late work by the great Farrukh Beg, another Persian-trained artist, is based on a Netherlandish engraving of Melancholia. Beg transforms the image with colors ranging from natural to artificial; they coalesce in a tree whose profuse leaves speak more of life's exuberance than its trials.

In this section there are almost as many text panels introducing different artists as there are paintings, which looks somewhat daunting but also indicates the Mughals' sense of their own historical importance: imperial biographies frequently mentioned favored artists. One was Abul Hassan, anointed by Emperor Jahangir as a "Wonder of the Age," the designation that gave this show its title. He is represented here by an exquisite drawing of St. John the Evangelist based directly on a Dürer engraving, an example of which hangs next to it. Made when Abul Hassan was but 13, it counters the assumption that Indian art is often psychologically thin by being more emotionally demonstrative than its inspiration.

The breadth of skill is often impressive. Another of Jahangir's "Wonders" was Mansur, equally at ease with exacting depictions of birds and reptiles and jewel-like manuscript illuminations in the Persian style. His contemporary Payag is represented by a portrait of Shah Jahan, a man of military bearing shown in profile on

a stallion bejeweled to the nines, that is among the world's most exquisite exercises in propaganda. Payag is also thought to have produced the wonderfully misty depiction of one of Jahan's sons hunting nilgais, a kind of antelope, at twilight. Take out the hunters and their prey and you have a landscape such as Corot might have painted. The work also signals something of an Indian specialty: the luminous nocturnal scenes that dot the show's second half.

As the second gallery gives way to the third the show suddenly shifts gears, turning to the diffusion of Mughal naturalism throughout provincial courts, both Hindu and Muslim. Various adaptations, integrations and rejections that the catalog accurately describes as "convoluted" unfold. A final flowering of Mughal-court art includes four works from around 1700 attributed to the idiosyncratic "Stipple Master," who all but eliminated color to concentrate on silhouetted figures enhanced by a finely dotted chiaroscuro that sometimes seems to presage Léger. His rococo lightness contrasts with the more emphatic bravura drawing of his near contemporaries the Hada Master and the Kota Master, who press Mughal naturalism into violent action in a series of stupendously detailed renderings of sometimes airborne battles between elephants.

Thereafter, the Rajput vocabulary formulated in the show's opening gallery prevails for a stretch. Color flattens and heats up across one long wall dominated by the works of masters, named and unnamed, of the courts of Nurpur, Bahu and Mankot in the Punjab Hills in the north. They achieve a balance of abstraction and representation — and a fusion of figure, architecture and landscape — equaled in European painting only by Sienese masters like Sassetta.

One folio, attributed to Golu of Nurpur, shows a handsome prince taking leave of his mistress in an image starkly divided between a brilliant white marble interior and an all-black nighttime landscape punctuated by five moonlit trees. These contrasting spaces are framed by bands of a deep orange whose intensity is echoed primarily by the lovers' garments, which are nonetheless detailed, and bejeweled, with Mughal finesse.

The stylistic convolutions really never cease in this show, which will reward several visits and is further enriched by Mr. Guy's and Ms. Britschgi's detailed yet accessible catalog. The last three galleries are almost as strong as anything that has come before, even though the Mughals are nearly gone and the smaller courts are fading in the face of squandered wealth and foreign powers.

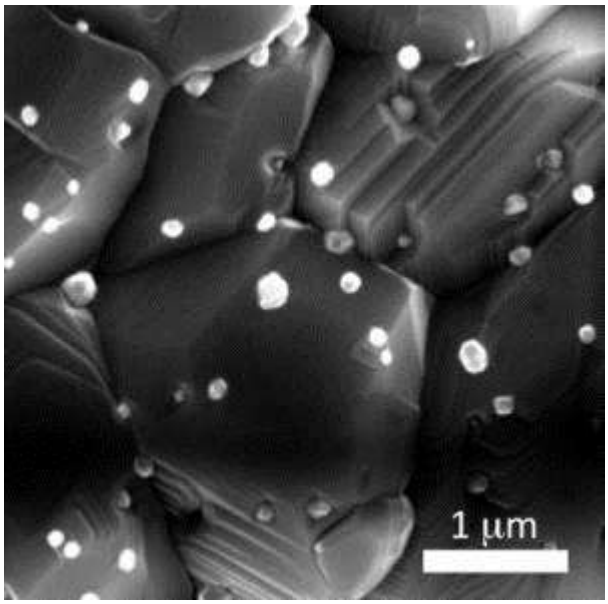
New and dazzling accommodations continue to be reached between India's two great traditions, only now they seem, in a way, to inhabit one another from within. At the court of Guler in the Punjab, an artist named Manaku lends a kind of Rajput fleshiness and abstraction to the Mughal detailing of nature in a folio based on the Gita Govinda, a 12th-century love poem illustrating Krishna's dalliances. This image of topographical sublimation offers a pastel, nearly labial ravine — full of snakes on one side and blossoming trees on the other — that illustrates the cooling of the south winds by the Himalayas. Manaku's brother Nainsukh revives a late Mughal tradition of refined figuration in tensile architectural interiors that are fine-boned versions of Rajput rooms.

These elements — Rajput flesh and Mughal bones — entwine and retwine to the end. In the final gallery Tara, the master of Udaipur court in the mid-19th-century, portrays the Hindu festival of Holi erupting in an immense square framed by delicate white facades that we see from multiple perspectives. Maharana Sarup Singh and his courtiers, mounted on elephants, fling colored powder and colored water into the air; the enveloping plumes of red, which might almost be spray-painted, liberate Rajput color from its flat blocks with startling force.

In this gallery, too, we see the real end of Indian painting in tinted photographs that indicate the embrace of photography by artists and patrons alike. And no wonder, since such verisimilitude was already in force, in Mughal realism, nearly 300 years earlier.

http://www.nytimes.com/2011/09/30/arts/design/putting-names-to-the-greats-of-indian-art.html

Engineers 'Cook' Promising New Heat-Harvesting Nanomaterials in Microwave Oven



Engineering researchers at Rensselaer Polytechnic Institute have developed new thermoelectric nanomaterials, pictured above, that could lead to techniques for better capturing and putting this waste heat to work. The key ingredients for making marble-sized pellets of the new material are aluminum and a common, everyday microwave oven. (Credit: Rensselaer/Ramanath)

ScienceDaily (Sep. 30, 2011) — Waste heat is a byproduct of nearly all electrical devices and industrial processes, from driving a car to flying an aircraft or operating a power plant. Engineering researchers at Rensselaer Polytechnic Institute have developed new nanomaterials that could lead to techniques for better capturing and putting this waste heat to work. The key ingredients for making marble-sized pellets of the new material are aluminum and a common, everyday microwave oven.

Harvesting electricity from waste heat requires a material that is good at conducting electricity but poor at conducting heat. One of the most promising candidates for this job is zinc oxide, a nontoxic, inexpensive material with a high melting point. While nanoengineering techniques exist for boosting the electrical conductivity of zinc oxide, the material's high thermal conductivity is a roadblock to its effectiveness in collecting and converting waste heat. Because thermal and electrical conductivity are related properties, it's very difficult to decrease one without also diminishing the other.

However, a team of researchers led by Ganpati Ramanath, professor in the Department of Materials Science and Engineering at Rensselaer, in collaboration with the University of Wollongong, Australia, have demonstrated a new way to decrease zinc oxide's thermal conductivity without reducing its electrical conductivity. The innovation involves adding minute amounts of aluminum to zinc oxide, and processing the materials in a microwave oven. The process is adapted from a technique invented at Rensselaer by Ramanath, graduate student Rutvik Mehta, and Theo Borca-Tasciuc, associate professor in the Department of Mechanical, Aerospace, and Nuclear Engineering (MANE). This work could open the door to new technologies for harvesting waste heat and creating highly energy efficient cars, aircraft, power plants, and other systems.

"Harvesting waste heat is a very attractive proposition, since we can convert the heat into electricity and use it to power a device -- like in a car or a jet -- that is creating the heat in the first place. This would lead to greater efficiency in nearly everything we do and, ultimately, reduce our dependence on fossil fuels," Ramanath said. "We are the first to demonstrate such favorable thermoelectric properties in bulk-sized high-temperature materials, and we feel that our discovery will pave the way to new power harvesting devices from waste heat."

Results of the study are detailed in a paper published recently by the journal *Nano Letters*.

To create the new nanomaterial, researchers added minute quantities of aluminum to shape-controlled zinc oxide nanocrystals, and heated them in a $40 microwave oven. Ramanath's team is able to produce several grams of the nanomaterial in a matter of few minutes, which is enough to make a device measuring a few centimeters long. The process is less expensive and more scalable than conventional methods and is environmentally friendly, Ramanath said. Unlike many nanomaterials that are fabricated directly onto a substrate or surface, this new microwave method can produce pellets of nanomaterials that can be applied to different surfaces. These attributes, together with low thermal conductivity and high electrical conductivity, are highly suitable for heat harvesting applications.

"Our discovery could be key to overcoming major fundamental challenges related to working with thermoelectric materials," said project collaborator Borca-Tasciuc. "Moreover, our process is amenable to scaling for large-scale production. It's really amazing that a few atoms of aluminum can conspire to give us thermoelectric properties we're interested in."

This work was a collaborative effort between Ramanath and Shi Xue Dou, a professor at the Institute for Superconducting and Electronic Materials at the University of Wollogong, Australia. Wollongong graduate student Priyanka Jood carried out the work together with Rensselaer graduate students Rutvik Mehta and Yanliang Zhang during Jood's one-year visit to Rensselaer. Co-authors of the paper are Richard W. Siegel, the Robert W. Hunt Professor of Materials Science and Engineering; along with professors Xiaolin Wang and Germanas Peleckis at the University of Wollongong.

This research is funded by support from IBM through the Rensselaer Nanotechnology Center; S3TEC, an Energy Frontier Research Center funded by the U.S. Department of Energy (DoE) Office of Basic Energy Sciences; the Australian Research Council (ARC); and the University of Wollongong.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Rensselaer Polytechnic Institute**.

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http://www.sciencedaily.com/releases/2011/09/110929122802.htm

Mechanism Uncovered for the Establishment of Vertebrate Left–right Asymmetry

Zebrafish. (Credit: iStockphoto/Andrew Ilyasov)

ScienceDaily (Oct. 1, 2011) — A research team at the Hubrecht Institute, Utrecht, demonstrates a mechanism by which left-right asymmetry in the body is established and maintained. The study, published in the open-access journal *PLoS Genetics* on September 29, offers a new model of how families of genes interact to promote and direct body asymmetry.

Although organisms appear bilaterally symmetrical when observed from the outside, internal organs are positioned asymmetrically along the left-right axis, and the organs themselves exhibit intrinsic left-right asymmetries. While complete organ reversal (situs inversus) rarely gives rise to medical complications, severe medical problems occur in infants with partial organ reversal (situs ambigious or heterotaxia), including improper connections of the major vessels to the heart. These heart defects are often lethal if not immediately corrected after birth by cardiac surgery, meaning that the establishment of correct left-right asymmetry is a critical process.

The researchers, led by Dr. Jeroen Bakkers, identified a receptor for bone morphogenetic proteins (BMP) as a regulator of left-right patterning in zebrafish using a forward genetic screen. Two growth factors, Nodal and BMP, have previously been shown to be important for orchestrating left-right asymmetry, but the mechanism and hierarchy for the regulation of this process had been unclear. The data presented in this study reveal a new mechanism by which these proteins pattern the embryo along the left-right axis, through the induction and maintenance of a genetic midline 'barrier'.

Dr. Bakkers and colleagues conclude that further studies are required to tease out whether there are species-specific differences during the development of embryonic left-right patterning, but this study and another by other researchers studying mouse development lend support for a conservation of this pathway in regulating organism left-right asymmetry.

Story Source:

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Journal Reference:

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http://www.sciencedaily.com/releases/2011/09/110929171658.htm