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Changing Race by Changing Clothes? Stereotypes and Status Symbols Impact If a Face Is Viewed as Black or White

A sample of the kinds of faces shown to participants in the study, which "shows how the perception of a face is always a compromise between the visual cues before our eyes and the baggage we bring to the table, like the stereotypes we hold," says Jonathan B. Freeman. (Credit: Image courtesy of Tufts University)

ScienceDaily (Sep. 27, 2011) — An interdisciplinary team of researchers from Tufts University, Stanford University and the University of California, Irvine has found that the perception of race can be altered by cues to social status as simple as the clothes a person wears.

Far from being a straightforward "read out" of facial features, say the researchers, racial categorization represents a complex and subtle process powerfully shaped by context and the stereotypes and prejudices we already hold.

"Looking the part: Social status cues shape race perception" appears in *PLoS ONE* published online September 26.

In the experiments, study participants were asked to determine the race of computerized faces. Faces accompanied by business attire were more likely to be seen as White, whereas faces accompanied by janitor attire were more likely to be seen as Black.

A novel hand-tracking technique -- which recorded participants' hand trajectories while using a mouse to select a racial category on the computer screen -- also revealed far more subtle influences of the stereotypical status cues.

Even when participants ultimately decided that a face with low-status attire was White or a face with high-status attire was Black, they showed that they were still drawn to the other race that was stereotypically tied to the status cue by moving the mouse slightly closer to that response before making their final decision.

The researchers then ran a series of computer simulations to show how the shifting of race perception by status cues naturally emerges in a system that is mathematically similar to a human brain -- so long as that system already associates Whites with high status and Blacks with low status.

"The study shows how the perception of a face is always a compromise between the visual cues before our eyes and the baggage we bring to the table, like the stereotypes we hold," says the study's lead author, Jonathan B. Freeman, a doctoral candidate in psychology at the Tufts Graduate School of Arts and Sciences.

The results highlight one of the possible mechanisms through which subtle and unconscious racism continues to occur.

"Racial stereotypes are powerful enough to trickle down to affect even basic visual processing of other people, systematically skewing the way we view our social world," Freeman says.

Status cues had the largest effects for the faces that were most racially ambiguous, a notable finding given recent and projected growth of the multiracial population in the United States.

The National Institutes of Health and the National Science Foundation provided funding for this work.

Story Source:

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Journal Reference:

1. Jonathan B. Freeman, Andrew M. Penner, Aliya Saperstein, Matthias Scheutz, Nalini Ambady. **Looking the Part: Social Status Cues Shape Race Perception**. *PLoS ONE*, 2011; 6 (9): e25107 DOI: 10.1371/journal.pone.0025107

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'The Managerial Unconscious'

September 28, 2011
By Scott McLemee

A familiar story about the modern university goes something like this: Once upon a time, the freshman arrived already knowing at least the basic mechanics of writing: what a paragraph was, how punctuation marks worked, the existence of nouns and verbs (and the obligation that they agree in a given sentence), that sort of thing. But the expansion of higher education throughout the 20th century, and especially in its second half, meant that a steadily growing portion of the student body needed basic training in such things.

The job naturally fell to professors of English, even though composition stood in relation to the study of literature roughly as long division did to algebraic topology, over in the math department. Still, it was necessary. Teaching this basic (even remedial) course helped justify offering the more advanced sections in literature. As the demand for writing instruction grew, it ceased being one task among others that the English faculty performed. It was became a function planned and administered separately from the courses on literature, and sometimes it even broke off from the department entirely, to do its own thing.

And that is why there is now a writing center on campus, probably in a basement somewhere, largely staffed by graduate students. There are faculty who specialize in composition studies, every single one of whom remembers that Cary Nelson, the president of the American Association of University Professors, once called them "comp droids" pursuing an activity devoid of any real intellectual content. That was more than 10 years ago, and in the original context it was a critique of literary scholars' attitudes. But the comp people still quote it sometimes, with bitterness, as if they've made a slogan of the militant online group Anonymous their own: "We are legion. We do not forgive. We do not forget."

There are various problems with this narrative, including the fact that happy compositionists do exist. (I have met them.) But the most important is the fable about the golden age when secondary education produced literate students, so that the English faculty could keep its attention focused on higher things. In *The Managerial Unconscious in the History of Composition Studies*, published by Southern Illinois University Press, Donna Strickland quotes various exasperated statements issuing from Harvard University in the 1890s. Professors were obliged to instruct "bearded men [in] the rudiments of their native tongue," so that "a large corps of teachers have to be engaged and paid from the College treasury to do that which should have been done before the student presented himself for admission."

Teaching composition was the manual labor of the mind: "In quantity," said a committee appointed by the Harvard Board of Overseers in its report from 1892, "this work is calculated to excite dismay; while the performance of it involves not only unremitted industry, but mental drudgery of the most exhausting nature." And keep in mind that the students in question -- the raw material to be processed in the sweatshops of the Harvard English department – were typically the product of prep schools, in an era when the only distracting form of electronic communication was the telephone.

'Twas ever thus, in other words. But demolishing the belief that basic writing instruction at the college level reflects some recent dysfunction in secondary education (especially public schools) is a fairly minor element in Strickland's argument.

The author, an assistant professor of English at the University of Missouri at Columbia, reconfigures the history of composition studies, rejecting the commonplace view that the field took shape on the margins of another discipline -- a humble (but all too necessary) pedagogical supplement to literary studies. *The Managerial Unconscious* is remarkably compact book, its points made with much concentration. Reading it more than once seems like a good idea. Here is a brief survey, offered with with all due trepidation by someone who has been through it just once.

The title might be a good way in. It alludes to Fredric Jameson's *The Political Unconscious* (1981), which offered "always historicize" as a slogan for cultural analysis.

Strickland follows this injunction by stressing an important thing about the emergence of university-level composition courses in the U.S. at the close of the 19th century: it coincided with a rapidly growing market for white-collar labor. As companies expanded, their internal structures became more complex. Mechanization and the division of labor in manufacture increased productivity, but coordinating manufacture and distribution required new layers of managerial staff, able to turn out reports, memos, press releases, and the like.

When bearded men at university were unable to write coherently, that, rather than how prepared they were to compose a theme on Keats, was the real issue. To occupy a slot in the corporate chain of command, they had to be able to put a pen intelligibly to paper. One member of the Harvard committee that scrutinized undergraduate writing in the 1890s was the chairman of the Massachusetts Railroad Commission -- an early expert on what would soon be called systematic or scientific approaches to management. The committee's stress on the drudgery involved in handling thousands of student compositions per semester echoes the managerial theme that work can and should be organized for greater efficiency.

"Whether the ideas of systematic management were employed consciously or unconsciously," writes Strickland, "articulating the correct divisions of labor in the teaching of English was clearly the burden of the committee's report." To produce enough skilled labor to manage American business, the university itself needed to retool.

So by Strickland's account, English professors did not shove composition out of literary studies like an unwelcome stepchild. Another dynamic was at work. Writing instruction became a discipline in Foucault's sense – a way of inculcating both skills and the capacity to perform in a corporate workplace. Can the student rework a paper to the prof's satisfaction, as a mid-management person might be called upon to revise a handbook? "Writing programs," says Strickland, "… were made possible not by the devaluing of student writing in the university but by its central function in an institution that depended on writing as a tool for surveillance and assessment."

The quest for managerial efficiency just happened to reinforce other power relationships: "The teaching of required writing [became], in the process of being divided from the English department in the name of efficiency, sometimes an entry-level position, more frequently in recent decades a position completely outside the tenure track. Because more stable, better paying faculty positions tended to be awarded to men, women often had little choice but to take on low-paying instructorships in composition."

And by the later third of the 20th century, the consolidation of composition studies as a distinct field (with its own journals, graduate programs, academic organizations, and book series) had an odd effect. In keeping with Strickland's title, the specialty behaves like one of Freud's patients -- running away from "the managerial unconscious," only to find it returning, just ahead. Comp studies established itself as an intellectual discipline. But one career track in it leads to supervising the labor of adjuncts and graduate students, preparing a syllabus that others will follow, and trying to keep the writing center's costs down and statistics up. Still, thinking of the field as having a managerial component meets resistance, given the "negative connotations for traditional humanist intellectuals," Strickand writes, "who have tended over the decades to distrust management as, at best, nonintellectual and, at worst, soul-murdering." Management is where you land after doing a really good job at Pizza Hut for a couple of years.

But if the shoe fits.... "Once organizations of any kind are organized hierarchically," writes Strickland, "with a class of experts structuring and overseeing the work of a group of nonexperts, management happens. Professionalism calls for control and systematization of knowledge, and management is the group of people who reinforce that." Much of the book is devoted to how the evasion of its managerial function has played

itself out over the years, even after the Council of Writing Program Administrators was established in the late 1970s. Strickland's tone is never harsh. But when she writes that "almost from the beginning of the organization, the WPA discourse showed an aversion toward so-called managerial tasks," somebody's ox is being gored.

Strickland's argument implies consequences – but *only* implies them. Greater lucidity about how the managerial legacy of composition studies is the prerequisite for creating better working conditions; she also suggests that it will help make writing instruction a way to develop students' critical intelligence. But just how any of that will happen is left unaddressed. *The Managerial Unconscious* feels like the first volume of something, rather than the last word. If its implications are hard to read, that is because they remain to be drafted.

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

Fossil of an Armored Dinosaur Hatchling: Youngest Nodosaur Ever Discovered

Fossil of the baby nodosaur. (Credit: Ray Stanford)

ScienceDaily (Sep. 27, 2011) — Researchers at the Johns Hopkins University School of Medicine with help from an amateur fossil hunter in College Park, Md., have described the fossil of an armored dinosaur hatchling. It is the youngest nodosaur ever discovered, and a founder of a new genus and species that lived approximately 110 million years ago during the Early Cretaceous Era. Nodosaurs have been found in diverse locations worldwide, but they've rarely been found in the United States. The findings are published in the September 9 issue of the *Journal of Paleontology*.

"Now we can learn about the development of limbs and the development of skulls early on in a dinosaur's life," says David Weishampel, Ph.D., a professor of anatomy at the Johns Hopkins University School of Medicine. "The very small size also reveals that there was a nearby nesting area or rookery, since it couldn't have wandered far from where it hatched. We have the opportunity to find out about dinosaur parenting and reproductive biology, as well as more about the lives of Maryland dinosaurs in general."

The fossil was discovered in 1997 by Ray Stanford, a dinosaur tracker who often spent time looking for fossils close to his home; this time he was searching a creek bed after an extensive flood.

Stanford identified it as a nodosaur and called Weishampel, a paleontologist and expert in dinosaur systematics. Weishampel and his colleagues established the fossil's identity as a nodosaur by identifying a distinctive pattern of bumps and grooves on the skull.

They then did a computer analysis of the skull shape, comparing its proportions to those of ten skulls from different species of ankylosaurs, the group that contains nodosaurs. They found that this dinosaur was closely related to some of the nodosaur species, although it had a shorter snout overall than the others. Comparative measurements enabled them to designate a new species, *Propanoplosaurus marylandicus*. In addition to being the youngest nodosaur ever found, it is the first hatchling of any dinosaur species ever recovered in the eastern United States, says Weishampel.

The area had originally been a flood plain, where Weishampel says that the dinosaur originally drowned. Cleaning the fossil revealed a hatchling nodosaur on its back, much of its body imprinted along with the top of its skull. Weishampel determined the dinosaur's age at time of death by analyzing the degree of development and articulation capability of the ends of the bones, as well as deducing whether the bones themselves were porous, as young bones would not be fully solid.

Size was also a clue: the body in the tiny fossil was only 13 cm long, just shorter than the length of a dollar bill. Adult nodosaurs are estimated to have been 20 to 30 feet long. Weishampel also used the position and quality of the fossil to deduce the dinosaur's method of death and preservation: drowning, and getting buried by sediment in the stream. Egg shells have never been found preserved in the vicinity, and by the layout of the bones and the size of some very small nodosaur footprints found nearby, led Weishampel to believe that the dinosaur was a hatchling, rather than an embryo, because it was able to walk independently.

"We didn't know much about hatchling nodosaurs at all prior to this discovery," says Weishampel. "And this is certainly enough to motivate more searches for dinosaurs in Maryland, along with more analysis of Maryland dinosaurs."

Stanford has donated the hatchling nodosaur to the Smithsonian's National Museum of Natural History, where it is now on display to the public and also available for research.

This study was funded by the Johns Hopkins Center of Functional Anatomy and Evolution.

Valerie DeLeon, also of the Center of Functional Anatomy and Evolution, was an additional author.

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Journal Reference:

1. Ray Stanford, David B. Weishampel, Valerie B. Deleon. **The First Hatchling Dinosaur Reported from the Eastern United States: Propanoplosaurus marylandicus (Dinosauria: Ankylosauria) from the Early Cretaceous of Maryland, U.S.A.**. *Journal of Paleontology*, 2011; 85 (5): 916 DOI: 10.1666/10-113.1

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Is the Bloom Off the Rose?

September 30, 2011
By Terry Connelly and Dan Angel

Rapidly deteriorating share prices; rampant short selling; abrupt quarterly declines in new customers, revenue and profits; proliferating federal and state investigations; multiple lawsuits; critical Congressional hearings and reports; executive resignations and replacements; proposals for significant new industry regulations; and endless talk of loan defaults.

No, this article is not about the mortgage finance industry or the Wall Street investment banking collapse -- although it could be. All these circumstances today surround an industry that for many people might conjure images of ivory towers rather than the steel and glass canyons of lower Manhattan: for-profit higher education.

Over the past three decades, for-profit colleges have designed and implemented a business model that propelled enrollment growth at six times the rate of other American universities. This outcome has occurred just as our economy demands that the U.S. produce significantly more workers with college credentials than we are now, and do so faster. To their credit, the for-profits have made a contribution to addressing our nation's "graduation gridlock" by catering to the growing mass of working adult students, while traditional universities have made only modest efforts to accommodate them.

Even as public and private nonprofit colleges and universities have been cutting budgets, staff, faculty, classes, programs, and student resources -- and still losing money -- the for-profit sector has continued to grow enrollments and profits until very recently. It did so by focusing on education as a business, structuring educational offerings to focus on students as *customers*.

But when some forgot this principle and in fact exploited their students (as well as the American taxpayer), they began a process of killing their "golden goose." Today's for-profit colleges have become captives, as well as beneficiaries, of the Wall Street money machines that created them. Many now find that their equity shareholders are turning their backs on them just when they need them the most -- a modern "live by the sword, die by the sword" parable. What has gone wrong for an industry that until recently was flourishing? Is the bloom indeed off the for-profit rose?

How They Got Here

The for-profits started with a clean slate in designing postsecondary degree programs without the baggage of academic systems or government structures that traditionally elevated academic policy (and faculty control) over business model considerations keyed to generating shareholder returns. They first created their own national accreditation bodies to vet their new educational models and thereby earn eligibility for federal education aid dollars, but then moved on to win approval by the 1990s for their nontraditional pedagogy by regional bodies that typically served as accreditors for traditional nonprofit private and state universities.

Despite their departures from traditional academic norms, the for-profits could thus show that they were accredited in exactly the same way as traditional colleges, which helped them win credibility with potential employers of their graduates. As a result, the sector grew enrollment tremendously over the past two decades among students eligible for federal financial aid. In turn, these students' federally subsidized tuition dollars funded the robust, sophisticated marketing campaigns that have sustained the for-profits' drive for even further enrollment increases to respond to their shareholders' expectations for continued top- and bottom-line growth.

Meanwhile, stubborn and foolish resistance among traditional higher education institutions to online learning models also gave the for-profit sector a golden opportunity to capture a significant "first-mover advantage." The for-profits pushed hard to remove major regulatory barriers to the expansion of postsecondary education via the Internet. They won a huge victory in 2006 when Congress eliminated the prohibition against providing federal education aid to programs delivered more than 50 percent online. While the change applied to all colleges, the for-profits' positive approach to Internet learning, contrasted with traditional institutions' foot-dragging, generated big increases in online enrollment in the for-profit sector even into the teeth of the Great Recession of 2007-9.

This surge was further abetted by another federal rule change that expanded the limit on the amount of tuition funding that an eligible higher education institution could receive from federal resources to 90 percent. This deregulatory change significantly increased the U.S. taxpayers' subsidy of higher education, for-profit style. Soon thereafter, *The Financial Times* showed how for-profits' operating margins were surpassing those of even the government-funded defense industry. One example noted was the two-year-old Bridgepoint Education, which reported an 85 percent increase in quarter-over-quarter revenues after the tuition limit was lifted, with a 32 percent operating margin after spending $44 million on marketing but only $39 million on education and student support.

A related driver of nonprofit online growth was the federal decision to exempt military educational assistance programs from the 90 percent limit on federal tuition sourcing. A U.S. Senate report this month showed that 37 percent of the $4.4 billion in federal military education aid dollars in fiscal 2011 went to the for-profit sector.

For-profits deserve commendation for being enthusiastic "first responders" to the special learning needs and circumstances of active duty soldiers and veterans On the other hand, a *New York Times* front-page article last year asserted that some for-profit military education programs "have come at substantial taxpayer expense while often delivering dubious benefits to students" -- setting them up to default on untenable debts they cannot cover even with the jobs that their degrees will qualify them for.

The for-profit sector's increasing profit margins are leveraged on a mountain of educational debt that mortgages an unsustainable proportion of for-profit students' future income. Ninety-six percent of all for-profit students use loans to pay for school, compared with 64 percent at public and 72 percent at private colleges. According to the College Board, for-profit graduates with bachelor's degrees carry an average indebtedness of $33,000 -- $13,000 more than public college graduates and $5,000 more than those finishing private colleges. The top recipients of federal student aid are all for-profit universities.

For-profit college *students*, however, are not profiting to the same extent. They are far more prone to default on their borrowings than students at other institutions of higher learning (perhaps because they are also less likely to finish their degrees). With 10 percent of higher education enrollment, they attract 25 percent of all federal aid dollars (including Pell grants, but also account for 25 percent of loan defaults and 44 percent of loan defaulters.

Loan defaults are truly a tragedy of the first order for students, especially for those who don't manage to complete their degree. Those who default on student loans may have their wages and tax refunds garnisheed by the government, lose their credit standing, and be denied mortgages, car loans, credits cards, and even rental apartments and jobs. But defaults are also a tragedy for the U.S. taxpayer over the longer term.

Not surprisingly, high default rates among students at for-profit colleges have captured the attention of a Congress and executive branch focused on the federal deficit, since the taxpayer, not the institution, is on the hook for loans not repaid.

Regulators seized on the statutory requirement that colleges must achieve learning outcomes that enable graduates to find “gainful employment” sufficient to pay off their loans as a possible leverage point for disciplining for-profit marketing practices and pedagogical effectiveness. Officials cited anecdotal evidence that “boiler room" recruitment tactics and lax academic standards at some institutions have led to a waste of taxpayer money on student loans with dubious likelihood of repayment

With their federal tuition aid lifeline under attack, the for-profits used their ample resources to fight back, not with educational “3 Rs," but with what could be called a “3 Ls” strategy: $8 million in lobbying; litigation against proposed new federal rules; and phantom “loans” to students, direct from the institution but written off after they bring aggregate tuition funding under the 90 percent limit.

The final rules enforcing the “gainful employment” mandate adopted by the U.S. Department of Education in June 2011 turned out to be more lenient than the original draft,. For a college program to be disqualified from federal education aid, more than 65 percent of its students would have to be delinquent in repaying their loans, and its graduates would also show loan debts that comprise more than 30 percent of their discretionary income, or more than 12 percent of their total earnings -- in each case, for three out of four years running. Thus no programs can be disqualified from receiving federal student aid until at least 2015.

Moving Forward

A perhaps more imaginative regulatory approach toward driving for-profit institutions toward a “best practice" model in recruitment and student retention practices would be to focus on the percentage of federally funded tuition that they spend on marketing as opposed to educating. The government surely has a legitimate interest in assuring that the bulk of its subsidies to the higher education sector are put to work in teaching and student support.

Just as the Affordable Care Act of 2010 has mandated a limit of 15 percent administrative expense for health insurance entities under certain federally subsidized coverage programs, Washington could look to setting a similar 15 percent limit on the amount of the 90 percent of government-funded tuition revenue maximum that for-profits (or any college, for that matter) can spend on advertising, call centers and other marketing activities. A sliding scale could be established with higher percentage limits applying for start-up institutions , and as dependence on federal subsidies decreases below 90 percent.

Such an approach would also level the playing field for nonprofit institutions (including community colleges and our own Golden Gate University) that appreciate the value of online platforms and also seek to serve the “working adult” and online markets the for-profits have captured, but without having to divert a massive share of tuition dollars to fund competitive marketing campaigns.

Because Golden Gate is routinely mistaken for a for-profit institution, given its focus on the same underserved higher education market, we have every interest in supporting whatever regulatory framework would clean up the excesses that have damaged the reputation of the for-profit sector.

The for-profits have up to now succeeded in keeping immense profits generated by their business model for themselves and their shareholders, while transferring the related student loan default risks to the U.S. taxpayer. *If the subprime mortgage financial crisis taught us anything, it should be at least that this kind of separation of risk from reward is a particularly dangerous brand of economic alchemy.*

Indeed, there is an eerie resemblance between practices at some for-profit schools and the subprime mortgage industry, not just in their common history of customer loan defaults, but also in their sophisticated telephone sales centers and aggressive marketing programs, which eat up almost as many federally subsidized tuition dollars as classroom and online instruction.

Some investment commentators have come to view the for-profit college industry as a clone of the subprime mortgage disaster zone. David Einhorn, a leading hedge fund guru, who correctly predicted Lehman Brothers' financial collapse, specifically advised investors to "short" for-profit college stocks because of such similarities. This view paints with too broad a brush, but a reform agenda is nonetheless timely and essential.

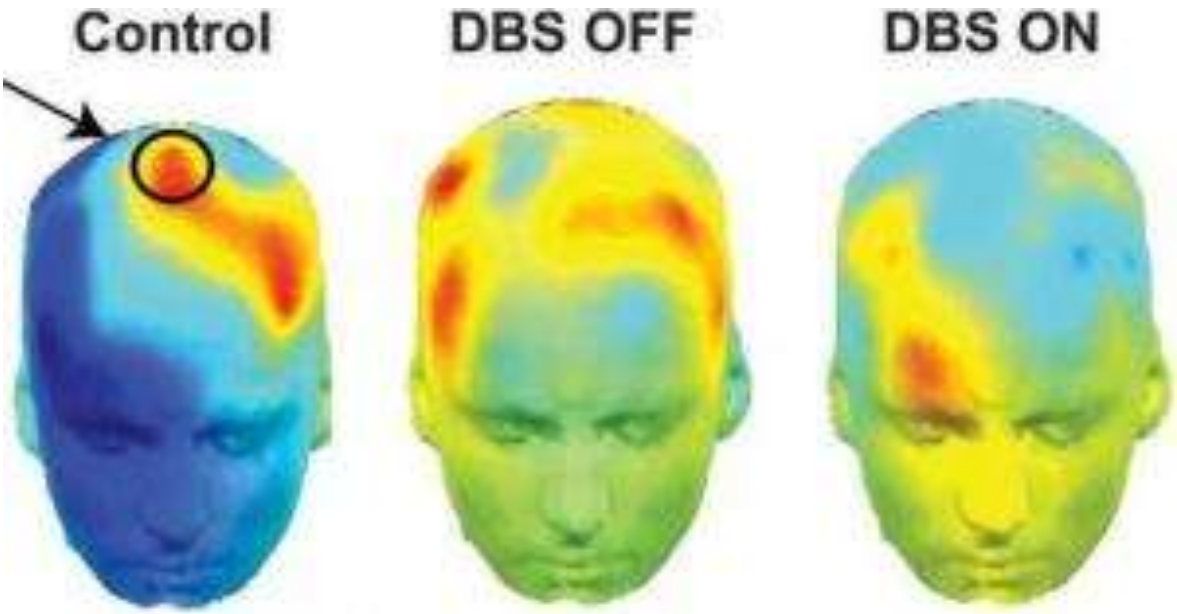
For-profit lobbying and promotional organizations have insinuated that the U.S, Department of Education is actually allied with, and even doing the bidding of, the Wall Street analysts and short-sellers who have been highly critical of the shadier aspects of some of the sector's business models. But even in a time rife with conspiracy theories, it smacks of desperation to suggest that the Obama administration is in cahoots with Wall Street speculators.

For-profit college managements should rein in their lobbyist and remember the names in the last business sector that tried to blame its regulatory and financial difficulties on the short-sellers: Lehman Brothers, Bear Stearns and Merrill Lynch, et al. That's a whole *bouquet* of roses that clearly lost their bloom!

Terry Connelly is dean of the Ageno School of Business and Dan Angel is president of Golden Gate University. They are the authors of Riptide: The New Normal in Higher Education, *from which this essay is adapted.*

http://www.insidehighered.com/views/2011/09/30/connelly_angel_essay_on_for_profit_colleges_putting_future_at_risk

Deep Brain Stimulation Studies Show How Brain Buys Time for Tough Choices



Red is for reflection. The hotter the color, especially in the circled area, the more likely the brain was to take its time making difficult decisions. Parkinson's patients whose deep brain stimulators were on (right), were more impulsive -- a cooler blue. (Credit: Frank Lab/Brown University)

ScienceDaily (Sep. 26, 2011) — Take your time. Hold your horses. Sleep on it. When people must decide between arguably equal choices, they need time to deliberate. In the case of people undergoing deep brain stimulation (DBS) for Parkinson's disease, that process sometimes doesn't kick in, leading to impulsive behavior. Some people who receive deep brain stimulation for Parkinson's disease behave impulsively, making quick, often bad, decisions.

New research into why that happens has led scientists to a detailed explanation of how the brain devotes time to reflect on tough choices.

Michael Frank, professor of cognitive, linguistic, and psychological sciences at Brown University, studied the impulsive behavior of Parkinson's patients when he was at the University of Arizona several years ago. His goal was to model the brain's decision-making mechanics. He had begun working with Parkinson's patients because DBS, a treatment that suppresses their tremor symptoms, delivers pulses of electrical current to the subthalamic nucleus (STN), a part of the brain that Frank hypothesized had an important role in decisions. Could the STN be what slams the brakes on impulses, giving the medial prefrontal cortex (mPFC) time to think?

When the medial prefrontal cortex needs time to deliberate, it recruits help in warding off impulsive urges from elsewhere in the brain."We didn't have any direct evidence of that," said Frank, who is affiliated with the Brown Institute for Brain Science. "To test that theory for how areas of the brain interact to prevent you from making impulsive decisions and how that could be changed by DBS, you have to do experiments where you record brain activity in both parts of the network that we think are involved. Then you also have to manipulate the system to see how the relationship between recorded activity in one area and decision making changes as a function of stimulating the other area."

Frank and his team at Brown and Arizona did exactly that. They describe their findings in a study published online in the journal *Nature Neuroscience.*

The researchers' measurements from two experiments and analysis with a computer model support the theory that when the mPFC is faced with a tough decision, it recruits the STN to ward off more impulsive urges coming from the striatum, a third part of the brain. That allows it time to make its decision.

For their first experiment, the researchers designed a computerized decision-making experiment. They asked 65 healthy subjects and 14 subjects with Parkinson's disease to choose between pairs of generic line art images while their mPFC brain activity was recorded. Each image was each associated with a level of reward. Over time the subjects learned which ones carried a greater reward.

Sometimes, however, the subjects would be confronted with images of almost equal reward -- a relatively tough choice. That's when scalp electrodes detected elevated activity in the mPFC in certain low frequency bands. Lead author and postdoctoral scholar James Cavanagh found that when mPFC activity was larger, healthy participants and Parkinson's participants whose stimulators were off would take proportionally longer to decide. But when deep brain stimulators were turned on to alter STN function, the relationship between mPFC activity and decision making was reversed, leading to decision making that was quicker and less accurate.

The Parkinson's patients whose stimulators were on still showed the same elevated level of activity in the mPFC. The cortex wanted to deliberate, Cavanagh said, but the link to the brakes had been cut.

"Parkinson's patients on DBS had the same signals," he said. "It just didn't relate to behavior. We had knocked out the network."

In the second experiment, the researchers presented eight patients with the same decision-making game while they were on the operating table in Arizona receiving their DBS implant. The researchers used the electrode to record activity directly in the STN and found a pattern of brain activity closely associated with the patterns they observed in the mPFC.

"The STN has greater activity with greater [decision] conflict," he said. "It is responsive to the circumstances that the signals on top of the scalp are responsive to, and in highly similar frequency bands and time ranges."

A mathematical model for analyzing the measurements of accuracy and response time confirmed that the elevated neural activity and the extra time people took to decide was indeed evidence of effortful deliberation.

"It was not that they were waiting without doing anything," said graduate student Thomas Wiecki, the paper's second author. "They were slower because they were taking the time to make a more informed decision. They were processing it more thoroughly."

The results have led the researchers to think that perhaps the different brain regions communicate by virtue of these low-frequency signals. Maybe the impulsivity side effect of DBS could be mitigated if those bands could remain unhindered by the stimulator's signal. Alternatively, Wiecki said, a more sophisticated DBS system could sense that decision conflict is underway in the mPFC and either temporarily suspend its operation until the decision is made, or stimulate the STN in a more dynamic way to better mimic intact STN function.

These are not trivial ideas to foist upon DBS engineers, but by understanding the mechanics underlying the side effect -- and in healthy unhindered decision making -- the researchers say they now have a target to consider.

In addition to Frank, Cavanagh, and Wiecki, another Brown author is Christina Figueroa. Arizona authors include Michael Cohen, Johan Samanta, and Scott Sherman.

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Story Source:

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

Journal Reference:

1. James F Cavanagh, Thomas V Wiecki, Michael X Cohen, Christina M Figueroa, Johan Samanta, Scott J Sherman, Michael J Frank. **Subthalamic nucleus stimulation reverses mediofrontal influence over decision threshold**. *Nature Neuroscience*, 2011; DOI: 10.1038/nn.2925

http://www.sciencedaily.com/releases/2011/09/110925185432.htm

Academic Performance and the BCS

September 29, 2011
By John V. Lombardi , Elizabeth D. Capaldi and Craig W. Abbey

Nothing captures our national enthusiasm for sports more than rankings.

We love them, consume them, argue about them, reject them, and embrace them. The industry of sports ranking keeps many print publication alive, and serves to inform tailgate celebrations throughout the college sports season with the illusion of substantive, scientific calibration of our sports enthusiasm. Among the many rankings, we of course have the BCS system that generates a list of what are presumably the best football teams in America, using methodologies praised by those whose teams score high and attacked by those whose teams fail to make the cut.

Those of us who inhabit the core of the university's academic environment share the enthusiasm for measuring and evaluating the quality of our institutions, although we have less enthusiasm for the endless ranked lists that appear in popular publications.

While some dote on the *U.S. News* rankings, which like their BCS counterpart rely on hugely unreliable opinion surveys, we, however, prefer our own system for evaluating the *Top American Research Universitie*s that recognizes the importance of successful performance among highly competitive institutions without requiring a simple top to bottom ranking that often distorts more than it informs.

For over ten years, The Center for Measuring University Performance, now located at Arizona State University, has produced an annual report on the *Top American Research Universities* that uses objective data on nine measures to put universities into categories according to their performance.

We measure research, of course, by the amount of research expenditures of each university in two categories: Total Research that includes all sources, and Federal Research that includes the peer reviewed research activities sponsored by the Federal government. In addition we collect information on Endowment, Annual Giving, National Academy Membership, Faculty Awards, Doctoral degrees awarded, Postdoctoral Fellowships supported, and average SAT scores of entering students. For a full discussion of all these measures, see the most recent edition of *The Top American Research Universities* (2010) available online.

Our interest in intercollegiate athletics is long-standing as college sports form such a significant element in so many prominent and successful research universities, and we published a discussion of that phenomenon some years ago in *The Sports Imperative in America's Research Universities* (2003) available online.

Given the recent attention to conferences and possible conference realignments, as well as national media attention to the academic quality of the universities in each conference, we thought it might be interesting to use our data to construct an index to the academic distinction of the universities in the six major BCS conferences. In our annual report, we group universities into clusters based on their performance among the top 25 or the second 25 on our measures.

A university that is in the top 25 on all nine of our measures, scores a 9 while a university that is in the second category falling between 26 and 50 in national rank would earn a 4.5. Some institutions fall into the top 25 on some measures and the second 25 on others. If they have six measures in the top 25 and three measures in the second 25, we would assign them an academic distinction score of 6 plus 1.5 or 7.5.

By combining these indexes of academic performance for the members of the conferences, we can produce a reliable indicator of the combined academic distinction of the institutions in each of the six BCS conferences.

It will come as no real surprise to those who watch our academic landscape to discover that the Big 10 leads the field with an academic distinction index of 55, followed closely by the Pac-12 with 48. The ACC falls some distance behind with an index of 28.5 and the SEC a significant distance away at 14, followed closely by the Big-Twelve and the Big East at 12.

As a reference, we also constructed an index for the Ivy League, to put all this into perspective. This premier academic conference would fall into second place, after the Big-10 and before the Pac-12.

Although the decisions about conference alignments and realignments turn primarily on issues of television, audiences, institutional athletic comparability, and of course money, the quality of an institution's athletic conference is one of the elements that helps universities create and sustain a reputation for high quality, much prized by prospective students and alumni.

As these data show, high powered academics and high powered athletics coexist in many first rank institutions. However, we also conclude that having a first rate athletic program is no guarantee of high-powered academics but that many first-rate research universities have no difficulty sustaining outstanding athletic programs.

The following table provides the summary data for each conference

John V. Lombardi is president of Louisiana State University, Elizabeth D. Capaldi is university provost and executive vice president at Arizona State University, and Craig W. Abbey is senior assistant vice president for institutional analysis at the State University of New York at Buffalo.

ACADEMIC INDEX FOR THE SIX BCS CONFERENCES AND THE IVY LEAGUE			
Conference / Institution	**Index**	**Number of measures in Top 25**	**Number of Measures in top 26-50**
Big Ten Conference	55	35	40
Indiana University - Bloomington		0	3
Michigan State University		0	6
Northwestern University		4	5
Ohio State University - Columbus		4	4
Pennsylvania State University - University Park		3	4
Purdue University - West Lafayette		1	5
University of Illinois - Urbana-Champaign		3	4
University of Iowa		0	5
University of Michigan - Ann Arbor		7	1
University of Minnesota - Twin Cities		6	2
University of Wisconsin - Madison		7	1
Pacific-12 Conference	48	38	20
Arizona State University		1	2
Oregon State University		0	0
Stanford University		9	0
University of Arizona		1	6
University of California - Berkeley		7	1
University of California - Los Angeles		7	1
University of Colorado - Boulder		1	3
University of Oregon		0	0
University of Southern California		5	4
University of Utah		0	2
University of Washington - Seattle		7	1
Washington State University - Pullman		0	0
Atlantic Coast Conference	28.5	16	25
Boston College		0	1
Clemson University		0	0
Duke University		7	1
Florida State University		0	0
Georgia Institute of Technology		1	6
North Carolina State University		0	2
University of Maryland - College Park		1	4
University of Miami		0	1
University of North Carolina - Chapel Hill		5	3
University of Virginia		2	5
Virginia Polytechnic Institute and State University		0	2
Wake Forest University		0	0
Southeastern Conference	14	8	12
Auburn University		0	0

Salty Water and Gas Sucked Into Earth's Interior Helps Unravel Planetary Evolution

Scientists have long argued about how Earth evolved from a primitive state in which it was covered by an ocean of molten rock, into the planet we live on today with a solid crust made of moving tectonic plates, oceans and an atmosphere. (Credit: © Stasys Eidiejus / Fotolia)

ScienceDaily (Sep. 26, 2011) — An international team of scientists has provided new insights into the processes behind the evolution of the planet by demonstrating how salty water and gases transfer from the atmosphere into Earth's interior.

The paper was published in *Nature Geoscience* on September 26.

Scientists have long argued about how Earth evolved from a primitive state in which it was covered by an ocean of molten rock, into the planet we live on today with a solid crust made of moving tectonic plates, oceans and an atmosphere.

Lead author Dr Mark Kendrick from the University of Melbourne's School of Earth Sciences said inert gases trapped inside Earth's interior provide important clues into the processes responsible for the birth of our planet and the subsequent evolution of its oceans and atmosphere.

"Our findings throw into uncertainty a recent conclusion that gases throughout the Earth were solely delivered by meteorites crashing into the planet," he said.

The study shows atmospheric gases are mixed into the mantle, inside Earth's interior, during the process called 'subduction', when tectonic plates collide and submerge beneath volcanoes in subduction zones.

"This finding is important because it was previously believed that inert gases inside the Earth had primordial origins and were trapped during the formation of the solar system," Dr Kendrick said.

Because the composition of neon in Earth's mantle is very similar to that in meteorites, it was recently suggested by scientists that most of Earth's gases were delivered by meteorites during a late meteorite bombardment that also generated visible craters on Earth's moon.

"Our study suggests a more complex history in which gases were also dissolved into the Earth while it was still covered by a molten layer, during the birth of the solar system," he said.

It was previously assumed that gases could not sink with plates in tectonic subduction zones but escaped during eruption of overlying volcanoes.

"The new study shows this is not entirely true and the gases released from Earth's interior have not faithfully preserved the fingerprint of solar system formation."

To undergo the study researchers collected serpentinite rocks from mountain belts in Italy and Spain. These rocks originally formed on the seafloor and were partially subducted into Earth's interior before they were uplifted into their present positions by collision of the European and African plates.

"The serpentinite rocks are special because they trap large amounts of seawater in their crystal structure and can be transported to great depths in the Earth's mantle by subduction," he said.

By analysing the inert gases and halogens trapped in these rocks, the team was able to show gases are incompletely removed by the mineral transformations that affect serpentinites during the subduction process and hence provide new insights into the role of these trapped gases in the evolution of the planet.

The study was done in collaboration with researchers from the Australian National University, Canberra and The University of Genoa, Italy.

Story Source:

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

Journal Reference:

1. Mark A. Kendrick, Marco Scambelluri, Masahiko Honda, David Phillips. **High abundances of noble gas and chlorine delivered to the mantle by serpentinite subduction**. *Nature Geoscience*, 2011; DOI: 10.1038/ngeo1270

http://www.sciencedaily.com/releases/2011/09/110926095335.htm

The Promise of Digital Humanities

September 28, 2011

WASHINGTON — "Secret plan to replace human scholars with robots," read Brett Bobley's first slide.

"Oops!" exclaimed Bobley, director of the office of the digital humanities for the National Endowment of the Humanities, feigning embarrassment. The audience, made up mostly of NEH grantees, laughed. They were here at the endowment's headquarters Tuesday to celebrate their roles in forging a new frontier for the humanities -- a category of academic fields at risk of turning fallow for lack of public support. While the digital humanists in attendance might not expect robots to replace scholars anytime soon, they are building tools that could facilitate insights into history, language, art and culture that human researchers might never have been able to glean on their own. And some say that could help restore public interest in the humanities.

Humanities research is often derided as gauzy and esoteric, and therefore undeserving of tax dollars. Amid financial crises, humanities departments at many public universities have been razed. But even amid cuts, there has been a surge in interest in the digital humanities -- a branch of scholarship that takes the computational rigor that has long undergirded the sciences and applies it the study of history, language, art and culture.

"While we have been anguishing over the fate of the humanities, the humanities have been busily moving into, and even colonizing, the fields that were supposedly displacing them," wrote Stanley Fish, the outspoken professor of humanities and law at Florida International University, on his *New York Times* blog in June.

"Everyone loves digital humanities this year," said Bobley, citing the praise from Fish as the cherry on top of a steady stream of positive media coverage that has buoyed public interest in humanities research that uses new, technology-heavy approaches to distill meaning from old texts and artifacts.

The NEH held a symposium on Tuesday for 60 recipients of its 2011 Digital Humanities Start-Up Grants, most of whom were given between $25,000 and $50,000. They were allowed two minutes each to describe their projects.

Some were oriented to teaching history via role-playing games. Heidi Rae Cooley, an assistant professor of new media studies at the University of South Carolina, presented one such project, called "Desperate Fishwives." The game "intends to introduce students to the kinds of social and cultural practices that would have been in play in a 17th Century British village," Cooley explained. Students will be tasked with accumulating resources, completing social rituals, and solving some societal ill "before church or state intervene," she continued. Afterward, students would render a prose account of their experiences — "and thereby learn of the nature and complexities of historiography."

Lisa Rosner, a professor of history at Richard Stockton College of New Jersey, presented her concept for a role-playing game called "Pox in the City." The game has similar educational goals to "Desperate Fishwives," although Rosner's has to do with public health in 19th-century Edinburgh. Players can assume the roles of doctor, patient, or smallpox virus.

Other projects, while less whimsical, had to do with enabling learners to "experience" historical events or places instead of reading off a page. John Wall, a professor of English at North Carolina State University, said he is trying to recreate the spatial and acoustic dynamics of a sermon in St. Paul's Square in order to better understand the likely effectiveness of the "public preaching" that emerged as the preferred method of public relations for church and political authorities in early 17th-century London.

Representing Data

Some grantees are trying to create visual representations, not of physical spaces, but of data. Several are looking to superimpose demographic and historical data onto geographic maps. One recurring theme in the presentations was the need for "linked open data" — types of research data that are tagged and stored in such a way that they can integrate with other research.

Linked open data could have the same leveraging effect that the World Wide Web had on computing, said Micki McGee, an assistant professor of sociology at Fordham University. For example: If one researcher had architectural data about New York City, and another had demographic data about the city, and each were able to cross-reference the other's data with her own, it would deepen the context and understanding for both. The Web allowed thousands of computers to stop talking only to themselves and start talking to each other, McGee explained. With linked open data on the rise, the same could soon happen with research data, she said.

In addition to making humanities research richer, this could also make it more relevant to non-academics, said Bobley, the NEH digital humanities director.

"I think there is a real attempt in the digital humanities to broaden beyond academia and make information widely available," Bobley said in an interview. "Linked open data is a very technical infrastructure, but the result of that is information that's shared widely for free. A lot of scholarly data over the last hundred years or so is locked up in expensive journals that the public could never afford to subscribe to.

"We're quite happy about how the digital humanities is, in some sense, opening up the scholarly world to a wider audience," he said.

That could be the key to winning back support for the humanities, suggested Doug Reside, digital curator of the performing arts at the New York Public Library.

"I think that's the way we will continue to make humanities scholarship relevant and sustainable into the future," Reside told *Inside Higher Ed*. "That really is the way the rest of the world is going, and if we're not performing those functions, then humanities as a whole are in even greater danger than they already are."

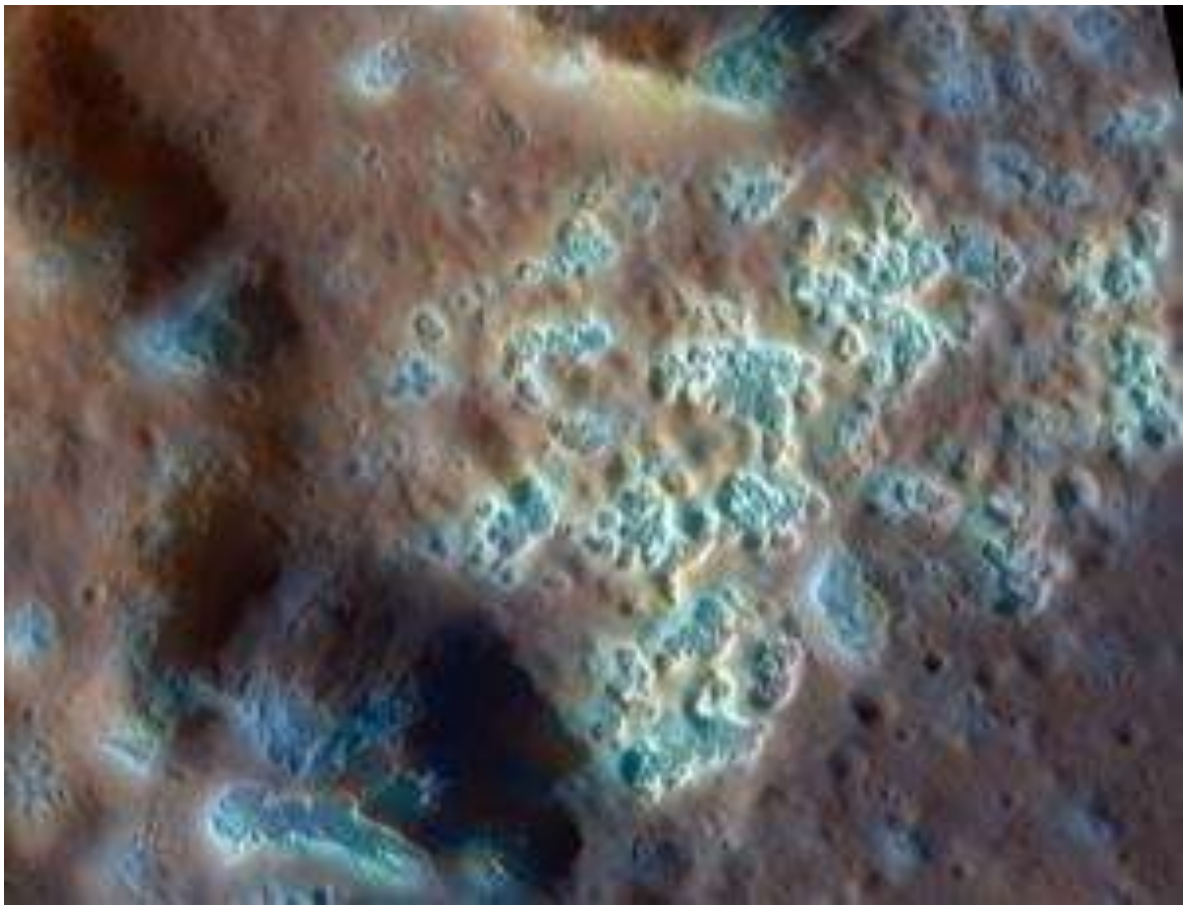
For the latest technology news and opinion from Inside Higher Ed, follow @IHEtech on Twitter.

— Steve Kolowich

http://www.insidehighered.com/news/2011/09/28/national_endowment_for_the_humanities_celebrates_digital_humanities_projects

Bright 'hollows' on Mercury are unique in solar system

- 21:57 29 September 2011 by **Lisa Grossman**



It's the pits *(Image: NASA/JHU APL/CIW)*

Mercury is covered with pits that are unlike anything else in the solar system, new observations from NASA's Messenger spacecraft show. They may have been formed by processes still active today, and change our view of the small rocky planet's history.

"The fact that these things are there at all is a big surprise," says David Blewett of the Johns Hopkins University Applied Physics Laboratory in Laurel, Maryland.

Messenger flew past Mercury three times before settling into orbit on 18 March. Those flybys – in 2008 and 2009 – revealed that some craters were filled with unidentified bright stuff.

Now, after more than a Mercury year (88 Earth days) in orbit, Messenger's high-resolution camera has revealed that the mysterious bright patches are clusters of shallow, rimless, irregularly shaped pits.

Each such "hollow" is between tens of metres to a few kilometres across and looks fresh and young – by planetary standards.

Spongy matrix

Other instruments on Messenger have found that Mercury's rocks contain a lot more volatile elements than expected. Blewett thinks the hollows formed when these elements – which are vaporised easily – were liberated from the surface, leaving behind a spongy, fragile matrix of soil that then collapsed.

Micrometeoroids and charged particles from the solar wind might have vaporised volatiles in the rocks, triggering the collapses.

Volatiles might also have been concentrated in pockets by volcanic eruptions that occurred during Mercury's long, frigid nights. In that case, volatile volcanic gases from the eruptions could freeze solid and get buried under lava flows. Later, a meteoroid impact could expose this material to sunlight, causing it to evaporate and the surrounding rock to crumble.

Smack unlikely

In either case, a lot of volatile stuff seems to be hiding beneath the surface of Mercury. That presents problems for theories that attempt to explain the planet's high density – an enormous two-thirds of its mass is made up of its metal core.

One theory argued that early on in the planet's life, the sun might have vaporised part of its rocky exterior. Another suggested that a large protoplanet smacked into it during its formation phase, blasting away its outer layers. In both cases, the heating involved would have evaporated volatile elements, allowing them to escape into space.

The fact that Messenger has found more volatiles than expected is stumping theorists trying to model Mercury's past. "The people who think about planetary-formation sorts of things are running back to their drawing boards," Blewett says.

Journal reference: *Science*, DOI: 10.1126/science.1211997

http://www.newscientist.com/article/dn20985-bright-hollows-on-mercury-are-unique-in-solar-system.html

Unkind to the Dutch

"Can none of your readers supply an English term, prefixed by 'Dutch', that is not pejorative?"
Published: 22 August 2011

In his review of an English dictionary of slang from the end of the seventeenth century, published on February 4, 2011, James Sharpe happened to draw a connection between the presence of a Dutchman on the English throne and pejorative slang terms of the time:

The presence of William III on the throne obviously set limits on the use of "Dutch" in pejorative expressions, but linguistic contacts paralleling the political ones were suggested by a scattering of entries explaining Dutch words or phrases: "gelt" for money; "Hans-en-kelder" for a jack-in-the-box or a baby in the womb; "placaert", defined as "a Dutch proclamation, an order of the States"; and "skipper", defined as "a Dutch master of a ship or vessel".

This led one reader to expand on the point, in the TLS of March 11:

Sir, — In his review of Jonathon Green's Dictionary of Slang, James Sharpe (February 4) lists items that, when prefixed with the adjective "Dutch", are unkind. Perhaps delicacy led him not to mention the Dutch wife, a long cylindrical bolster with which people once slept in the tropics: wrapping one's legs around it during the night prevented their becoming glued together with sweat. (Or was this Green's omission?) Can none of your readers supply an English term, prefixed by "Dutch", that is not pejorative?

GIGI SANTOW
45 Kareela Road, Cremorne, New South Wales.

March 18:

Sir, — In response to Gigi Santow's request (Letters, March 11) for any English term, prefixed by "Dutch" that is not pejorative, we can consider "Dutch cap" (a form of contraception), "Dutch uncle" (someone who gives benevolent, even if firm, advice) and, possibly, the nautical "Dutchman's breeches" (a small patch of blue sky seen when a gale is breaking). On the other hand, the word "Dutchman" was for many years a derogatory and offensive name for an Afrikaner used by English-speakers in South Africa.

STEPHEN FINN
Department of English, University of Pretoria.

Sir, — "Dutch treat" means that people share the bill. Nothing pejorative about that — unless you expect to be treated.

ROBERT SCHOLES
Department of Modern Culture and Media, Brown University, Providence, Rhode Island 02912.

Sir, — Non-pejorative use of Dutch? Gin?

J. P. C. BANNERMAN
Redcliff Cottage, Clift Place, Bristol.

April 1:

Sir, — Gigi Santow asks: "Can none of your readers supply an English term, prefixed by 'Dutch', that is not pejorative?" (Letters, March 11). I wondered if Dutch blue, Dutch pink, Dutch ultramarine, or Dutch white might qualify, names for certain pigments used by oil painters and artists' colourmen since the eighteenth century. However, on making further inquiries, I find that Dutch blue is merely a modification of Prussian blue, in other words diluted with lead white and Paris white (a type of fine chalk). Dutch pink is actually yellow; a German dictionary published in 1798 speculated that "pink", here, was ultimately derived from pinkeln, "to piss, or make water". Dutch white seems to have been a mixture of lead white and Barium sulfate, also known as Tyrol white, terra ponderosa vitriolata, or "stinking stone" (in a ratio of 1:3). Dutch ultramarine, meanwhile, is not ultramarine at all (derived from precious lapis lazuli), but another name for the much cheaper, grittier smalt (ground glass tinted with cobalt). These uses of "Dutch" hardly indicate unqualified praise, so I suppose we are left with "Dutch oven".

ANGUS TRUMBLE
Yale Center for British Art, 1080 Chapel Street, New Haven, Connecticut 06520.

April 15:

Sir, — You can end your search for "Dutch" used attributively but not pejoratively (Letters, April 1) in "the little town of Cherryvale, Kansas", of almost a century ago. It was there that the mother of the child dancer Louise Brooks, "in the interests of improving my stage appearance, had a barber chop off my long black braids and shape what remained of my hair in a straight Dutch bob with bangs". No hint of censure there. Of course, by the time Brooks incarnated the definitive screen Lulu (1929), her coiffure had been refined into the famous "helmet", troublingly combining allure, danger and paradoxical invulnerability. But no guardian of morality has blamed the Dutch.

MARTIN LEVINE
7401 Eastmoreland Road, Apartment 916, Annandale, Virginia 22003.

The search for "Dutch" slang, pejorative or not, finished on April 29:

Sir, — According to Food, by Waverley Root (1980), in Alabama, frogs are jokingly called Dutch nightingales (see Letters, April 15).

DAVID HAWKINS
130 Eighth Avenue, Apt 2A, Brooklyn, New York 11215.

http://www.the-tls.co.uk/tls/public/article706974.ece

Light of life: The hunt for another Earth

- 28 September 2011 by **Lee Billings**
- Magazine issue 2831.

Is anybody out there?

If we spied another living world in the distant cosmos, how would we recognise it?

JUST over 400 years ago, Galileo Galilei turned his newly constructed telescope towards Earth's moon. What he saw there reminded him of home: a dappling of lighter and darker areas where sunlight played across the lunar surface. As he wrote in his 1610 treatise *Siderius Nuncius*: "If the sphere of the Earth were seen from a distance, when flooded with the Sun's rays, that part of the surface which is land would present itself to view as brighter, and that which is water as darker in comparison." The moon, like Earth, Galileo concluded, was a world of lands and seas. And as his contemporary Johannes Kepler noted, where there are lands and seas, there could be life. Perhaps, indeed, life had built the moon's large, near-perfectly circular craters.

They were by no means the last to be seduced by signs of life where no life exists. Wherever we look beyond Earth, we are eager to spot our ilk. William Herschel, the celebrated astronomer who discovered infrared radiation and the planet Uranus, noted roads, towns, pyramids and regions "tinged with green" on the moon. Early observers attributed fluctuating dark patches on the surface of Mars to the seasonal growth of vegetation. Venus's cloud-covered face was long thought to obscure a humid twin of Earth with hot, lush jungles, or perhaps a warm global ocean teeming with life.

Today we know the moon is lifeless and sterile, its blotches immense plains of solidified magma. Mars's dark patches are dust storms; Venus's friendly exterior obscures a choking greenhouse of sulphurous fumes. Time after time, life's signatures have been written in disappearing ink.

That is something to chew over as we enter a new era of planetary discovery. In less than two decades, we have spied about 600 worlds orbiting other stars. This year alone, the Kepler space telescope, NASA's dedicated planet hunter, has added over 1700 candidates to the list. A few finds from Kepler and elsewhere seem to be roughly the size of Earth and in orbits that just might allow liquid water to exist, providing a solvent bath in which carbon-based life could evolve and flourish. In short, it won't be long before we spot another planet that might conceivably harbour life, if indeed we haven't already. But would we know it if we saw it - and if so, how?

Fittingly, it was Galileo who first showed us what a life-bearing world looks like from afar. Not Galileo the astronomer, but Galileo the NASA spacecraft. En route to Jupiter in 1990, it briefly turned its suite of remote-sensing instruments - cameras and spectrometers to record the emission and absorption of light - towards Earth from 960 kilometres away. Would it see an obviously living planet?

Astronomer Carl Sagan and his colleagues reported that Galileo's visible-light camera spied a contrast between darker areas and brighter areas. Earth's absorption spectrum also contained the signatures of water vapour and carbon dioxide. Water vapour suggests abundant surface water, possibly in liquid form; carbon dioxide indicates a rocky planet, since in gas-giant worlds this gas would combine with readily available hydrogen to form simple hydrocarbons such as methane. Piecing all this evidence together, we might then interpret the dark areas as oceans and the bright areas as land (*Nature*, vol 365, p 715).

A beacon of photosynthesis

Some of those bright areas also had an odd spectral characteristic: they efficiently absorbed visible wavelengths corresponding to the peak of the available solar energy, but reflected less prevalent infrared. We might have recognised this as the signature of chlorophyll in surface vegetation, efficiently and selectively taking advantage of the light resources available to it. Earth's plants shine a beacon of photosynthesis into space.

This was not the most compelling piece of evidence for life, however. That came in the form of the spectral signatures of abundant oxygen and a significant concentration of methane side by side in Earth's atmosphere. This juxtaposition is chemically implausible. Oxygen is highly reactive; it readily oxidises methane into water and carbon dioxide. If even just a little methane persists in an oxygenated planet's environment, some thermodynamically improbable process must be constantly replenishing it. In Earth's case, that something is life. Oxygen is the metabolic by-product of photosynthesising organisms. A vanishingly small amount of methane is produced by slow geological processes in Earth's crust, but most of it is the exhaust of a diverse and ancient group of microbes that reside in such oxygen-poor Earthly environments as swamps, rice paddies and the stomachs of ruminant animals.

All in all, the Galileo probe's evidence added up to a reasonably convincing identification of life seen from about 1000 kilometres away. But would such signals be recognisable over the tens to hundreds of light years that separate us from most planets we have discovered in other solar systems?

In theory, the answer is yes. Indeed, NASA's Hubble and Spitzer space telescopes have already obtained crude atmospheric spectra for a handful of exoplanets. That, however, has largely been through happy chance: such observations are limited to hot, extremely large gas giants that are precisely aligned to move periodically across the faces of their stars as seen from Earth. This "transit" configuration allows starlight to shine through the planet's puffy, extensive upper atmosphere, revealing spectral features.

The Kepler telescope uses the transit method to detect much smaller, cooler planets more akin to Earth. But it isn't nearly powerful enough to collect the trickles of starlight that filter through these diminutive planets' atmospheres. Typically, it can measure their sizes and orbital characteristics, but little else.

That situation is unlikely to change any time soon. "Kepler is finding worlds that look really intriguing, but there are no missions in the pipeline to follow up on these initial discoveries," says Victoria Meadows, a planetary scientist at the University of Washington in Seattle. Capitalising on what we might see will require an alternative approach.

Meadows heads the Virtual Planetary Laboratory (VPL), a network of scientists brought together by NASA, which aims to provide just that. Its goal is to use computing muscle to quantify the astrophysical, atmospheric and geological factors that influence whether a planet can harbour life, and model how these factors change a habitable planet's appearance over time. We can then zoom out from these modelled virtual worlds and see how they would appear viewed from light years away, at all angles and at all stages in their history. The aim, says Meadows, is to create a "Swiss army knife" of tools that, when presented with data on a new planet from Kepler or elsewhere, will tell us something about its likelihood of bearing life.

There's one type of habitable planet we find easiest to model. A cornerstone of the VPL project is the "Earth in a box" - a sophisticated three-dimensional mock-up of our home world which can be viewed from all possible vantage points and under different solar illuminations. In a paper published in June this year, Meadows and her colleagues compared this model with actual space-borne observations and showed that it reproduces our planet's fluctuating brightness and light spectrum to within 3 to 5 per cent accuracy (*Astrobiology*, vol 11, p 393).

The advantage of this virtual home is that it is mobile: we can drag our twin to anywhere in the cosmos to see what we would make of it there. "It allows us to explore what Earth would look like if it were being observed from very far away as it orbited around its star," says Meadows.

So how would it look? For a start, it would appear blue. That fits with our self-image as an ocean planet, but in fact it has less to do with the sea's azure hue and more with why the sky looks blue: molecular gases such as oxygen and nitrogen in Earth's atmosphere preferentially scatter the bluer portions of sunlight, colouring our view up and out - and also from outside looking in. The VPL's modelling suggests that, by measuring the ratio of certain wavelengths of ultraviolet and visible light reflected from an alien planet, we might detect this scattering from very far away. That would be a tantalising hint that at least one other similarly lively world abides beneath a friendly blue sky (*Astrophysical Journal*, vol 729, p 130).

Leaps of faith

With luck we might still see oceans. If we just happen to observe a distant Earth-like planet from an angle so that the side facing its host star is almost entirely turned away from us, we will see a thin arc of illuminated surface, similar to a crescent moon. As an ocean-covered region rotates into this planetary sliver, light will bounce off the water's flat, mirror-like surface, increasing the sliver's reflectivity and glinting the signal of oceans across the light years (arxiv.org/abs/1008.3864). An analogous shift in contrast between a planet's thick atmosphere and an airless lunar surface might also reveal a large moon like ours as it orbited across a planet's face. That would be a promising sign of habitability: our unusually large satellite is a crucial factor in correcting Earth's otherwise chaotic axial tilt, and helps ensure stable climatic conditions in which life can thrive.

All this is very well, but just because life might plausibly be somewhere does not mean it is. Relying too much on finding characteristics similar to those of our own planet invites the same leaps of faith about the existence of life that we have been prone to in the past - with the same likelihood of a fall. That is why VPL's

modelling aims to aid the more direct approach of looking for the by-products of life in planetary atmospheres.

Even without the added problems of viewing over many light years, this is a fraught business. The most obvious signatures of life are spread out through the spectrum, with water vapour and oxygen at visible and near-infrared wavelengths and methane, carbon dioxide and oxygen's molecular cousin, ozone, at longer infrared wavelengths. That makes it difficult to observe all of them with any one telescope.

Reliable models that can be applied to many environments could help sort out some of this confusion. A typical task for the VPL's researchers might be to compute how light from a star different in size, temperature, and luminosity from our sun will affect a planet in a habitable orbit, by heating it more or less, or through creating and destroying compounds in the air or on the surface - for example turning molecular oxygen, O_2, produced by life into ozone, O_3.

"These sorts of modelling efforts will tell us things like how important it is to look for oxygen versus ozone, or where the best spectral region is to look for water, or which star types are really worth looking at," says Charles Beichman of the NASA Exoplanet Science Institute in Pasadena, California. "In each case, we want to look for whatever gives us the most leverage for learning exactly what kind of planet we're studying."

History being what it is, the need to identify false positives looms large. Oxygen is a case in point. Our near neighbour Venus possibly once had an ocean billions of years ago, until plentiful sunlight and its CO_2-rich atmosphere contrived to spark a runaway greenhouse effect that boiled off its seas. Ultraviolet sunlight would then have gradually broken these airborne water molecules down into oxygen and hydrogen. The lighter hydrogen would have drifted off into space, but the oxygen would have persisted for many millions of years, gradually bonding with the surface rocks. Catch such a planet at the right time, and its hellish landscape would be veiled beneath an inviting facade of water vapour and breathable oxygen.

A similar deception could take place on a frozen, geologically inert world rather like modern Mars, but slightly more massive and with a more substantial atmosphere. There, for lack of volcanic gases and fresh rocks with which to react, the oxygen from any sublimating water ice might build up essentially indefinitely - a sign of life where none exists. "For an Earth-sized planet in the middle of the habitable zone of a sun-like star, perhaps most of the time atmospheric oxygen will be a biosignature," says Meadows. "But outside of that narrow space we have to be very careful."

Earth's own history shows that even more caution is necessary before interpreting an absence of oxygen as an absence of life. Though life is thought to have sprung up relatively quickly on Earth, probably within Earth's first billion years, it took a further billion years before oxygen reached appreciable atmospheric levels, about 2.4 billion years ago. Before that, methane from the ancient, anaerobic microbial biosphere would have been the most readily observable atmospheric biosignature. But methane alone is no cut-and-dried indicator of life: it can be made in small amounts through lifeless interactions of hot water and rock deep within a planet, as indeed it is on Earth. That methane could slowly seep out into an atmosphere and, in the absence of oxygen to mop it up, linger there. That leaves us with a conundrum. "We've only had an oxygenated atmosphere for half of our planet's lifetime," says Meadows. "So what the heck do we look for besides methane in an anoxic environment?"

According to Tori Hoehler, an astrobiologist at NASA's Ames Research Center in Moffett Field, California, the answer to that question might come from seeing life in terms of its function as a chemical catalyst. "Methane in Earth's atmosphere represents the fact that life could gain chemical energy by putting carbon dioxide and hydrogen together," he says. But that is not a one-step process - and the intermediate products vented from known anaerobic metabolisms might give us new clues as to what to look for on a distant planet.

Meadows and her team have taken this idea on board and focused on how "organosulphur" compounds such as methanethiol or dimethyl sulphide, which are produced in great quantities by some anaerobic microbes on Earth, might manifest themselves on a faraway planet. "We identified fluxes that could come from life at the surface, had them interact with the planet's atmospheric chemistry and ultraviolet light from the parent star, estimated their atmospheric lifetimes, and generated the resulting spectra," says Meadows.

What emerged was a surprise. Methanethiol and dimethyl sulphide were plentifully produced, but the action of ultraviolet light rapidly knocked off their methyl groups, which combined in pairs to form ethane gas. Ethane, while colourless and odourless, has a clear infrared spectroscopic signature and a significant atmospheric lifetime. A possible signature of an anoxic, but living, planet, the researchers concluded, is a high atmospheric ratio of ethane to methane (*Astrobiology*, vol 11, p 419).

That is a significant result, as this ethane build-up should be particularly potent in planets around cool, diminutive stars called M-dwarfs. For a planet in such a situation to have liquid water, it would orbit practically cheek by jowl with its stellar host - well within Mercury's distance from the sun - making it easier to discover through the gravitational wobble that its tight orbit would induce on the star. These could be the first living worlds we discover beyond our solar system - although the wrenching gravitational forces and intense ultraviolet radiation on such planets might make even familiar life forms difficult to recognise.

For such worlds and more familiar ones, the modelling initiative is slowly producing a long list of esoteric processes that could both help and hinder the identification of life. "We are revealing the complexity behind initially simplistic assumptions about habitable planets and how to find them," says Meadows.

Ultimately, though, that can only take us so far without the right data. NASA's James Webb Space Telescope, slated for launch no earlier than 2018, could probably obtain low-resolution atmospheric spectra for a few potentially habitable M-dwarf planets as they transit across the faces of their stars. Besides that, we are likely to be left guessing about what the light of life will look like. "The VPL and similar projects are going to help guide the design of future telescopes by telling us what astrobiologists really want to look at," says Beichman.

Whether those telescopes are built is another matter. Just imagine, though, some day seeing with imperfect vision blurry pricks of blue scattered through the sky, some winking with oceans, a few blanketed with what could be the breath of life. Who wouldn't want to take a closer look?

Not in my backyard?

As we begin to consider what signs of life might come from other solar systems (main story), intriguing possibilities still exist closer to home.

• **Mars** A few billion years ago, Mars was a lot more like Earth, with a clement climate and abundant liquid water. Today, liquid water might exist in subsurface reservoirs. Mars orbiters and remote-sensing instruments on Earth have also detected faint whiffs of methane seasonally wafting from the depths - signs, perhaps, of life that has long since retreated to a safe and hidden refuge.

• **Venus** This near neighbour was also once a much more amenable environment for life. Close examination of Venus's stifling clouds today has revealed mutually reactive hydrogen sulphide and sulphur dioxide, as well as carbonyl sulphide, a substance produced on Earth chiefly by biotic processes. That nourishes a controversial theory that microbes could live on high in the planet's atmosphere, shielded from harmful ultraviolet rays by protective sulphur rings.

• **Europa** If evidence from NASA's Galileo mission is anything to go by, this moon of Jupiter boasts a deep salty ocean beneath its icy crust, which is itself filigreed with fissures and veined with organic compounds

(picture, right). If the crust is not too thick, those energy-rich organic compounds might channel nutrients into an aquatic biosphere.

• **Enceladus** In 2005, the Cassini orbiter spied active geysers pluming from near this Saturnian moon's south pole, providing evidence of warm pockets of liquid water just beneath the surface. It is unclear whether life could have arisen there - but any microbe vacationing from Earth would find conditions there quite hospitable.

• **Titan** The Cassini mission's observations of Saturn's largest moon reveal not one but two promising abodes for life. Titan's crust appears to float on a vast ocean of liquid water and ammonia in which life not that dissimilar to Earth's could perhaps exist. Meanwhile, something seems to be depleting the hydrocarbons ethane and acetylene on the moon's frigid surface. That might indicate exotic carbon-based life with a hydrogen-fuelled metabolism that uses liquid methane rather than water as a solvent. Could this be a first glimpse of a "second genesis" of life on a completely different basis to Earth's?

Exotic possibilities

Just as oxygen, methane and other gases can suggest the presence of a biosphere hungry for chemical energy (main story), the prevalence of easily metabolised, energy-rich materials in a warm, rocky planet's atmosphere might constitute an "anti-biosignature" - evidence for a world bereft of life. According to planetary scientist Yuk Yung of the California Institute of Technology in Pasadena, finding an abundance of something easily digestible like hydrogen in such a planet's spectrum would be equivalent to seeing masses of windblown paper currency billowing through a city's streets. In both cases, the chances are good that nobody lives there.

This, of course, at least partially assumes the primacy of carbon-based chemistry. The signatures of life built out of strange things like silicon or magnetised plasma or neutrinos, or organisms using energy sources such as radioactive decay or matter-antimatter annihilation, are extremely ill-defined. In large part that is because it is unclear how such creatures would perform many of the activities that underpin our definitions of life, such as metabolism, growth, reproduction and evolution.

An alternative possibility that does not depend on biology is to look for inadvertent "technosignatures" of life. Taking cues from Earth's own recent history, when artificial chlorofluorocarbon (CFC) refrigerants proved remarkably adept at disrupting the photochemistry of our atmosphere's ozone layer, perhaps we might seek on other worlds the spectral signatures of gases believed to be produced solely through technology and engineering. It might be a bleak identification: such artificial substances could endure as mute testaments to life, regardless of its biochemistry, long after a civilisation had burned itself out.

***Lee Billings** is a freelance writer based in New York*

http://www.newscientist.com/article/mg21128312.000-light-of-life-the-hunt-for-another-earth.html?full=true&print=true

Should we mourn the end of chick-lit?

The Bookseller has reported a 10% fall in sales of chick-lit titles. So is this the end for a much-derided genre? Elizabeth Day and Tasmina Perry debate the state of women's fiction

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    - Elizabeth Day and Tasmina Perry
    - The Observer, Sunday 2 October 2011

Renee Zellweger as Bridget Jones: 'as smart a satire as anything by PG Wodehouse'. Photograph: Ronald Grant Archive

***Elizabeth Day,* Observer *feature writer and author of* Scissors Paper Stone**

I don't mourn the end of chick-lit, not because I don't admire it when it's done well but because the term has lost all meaning. It has become a catch-all label for a generic mass of pink-jacketed books with hand-illustrated covers depicting stilettos and Martini glasses.

By buying into "chick-lit" we are buying into the notion – perpetuated by publishers – that, as women, we require a different genre of fiction. That is harmful, not just because it's patronising, but because it undermines the work of the author too.

There are some brilliantly written, warm, funny and insightful examples of so-called "chick-lit", but because they have all been lumped in together and marketed so obviously at women (or, at least, the type of women marketing departments imagine spend their days eating cupcakes and watching re-runs of *Sex and the City*), the quality of the work gets ignored.

As a consequence, the idea that men and women like different books has gained a depressing currency. It's interesting that although "chick-lit" has been seamlessly assimilated into our language, there is no male equivalent. Men, you see, don't need their own category. They have serious literature, not "dick-lit".

Tasmina Perry has published five novels; her latest is **Private Lives**

According to recent obituaries of chick-lit , this much derided literary genre is a very broad church indeed. Apparently Jodi Picoult, whose plotlines include ambivalent motherhood, gay rights and date rape, is a chick-lit author. So too is Marian Keyes, who has tackled the issues of domestic abuse and alcoholism. And so am I. My latest book, *Private Lives*, is a peep behind the curtains in a media law firm. As a well-read friend recently told me, it's the only book with a pink cover that examines the Reynolds defence, but that hasn't stopped dozens of people asking me how I became a chick-lit writer.

I think it's because we're women. You don't get David Nicholls isn't name-checked in close proximity to the words chick-lit, even though *One Day*'s Emma Morley could hardly ever find a boyfriend. We write unapologetically commercial fiction with the aim of entertaining our readers, not winning Pulitzer prizes. And it's not so much the publishers who are guilty of pigeonholing us (come on, one of Jodi's books had toy soldiers on the front cover) but the public at large. After all, "chick-lit" trips off the tongue a lot more neatly than "women's commercial fiction" when you're describing what you read on your sun-lounger.

If it's a lazy label for women writing for other women, then there's lots of terrific, well-written examples out there. *Bridget Jones* was as smart a satire as anything written by PG Wodehouse. Allison Pearson's *I Don't Know How She Does It* might have had a peony-hued jacket but it made me both laugh out loud and cry like a baby within a few chapters.

Chick-lit isn't meant to change the world. It's meant to go rather nicely with a hot bath and a glass of wine and it can sit happily on your bookshelves alongside Ian McEwan, just as I love Michael Bay movies as much as Powell and Pressburger – different movie directors for different moods.

Are there any poorly written, derivative examples of chick-lit out there? Absolutely. Has this sector been over-published because it's made the book industry a lot of money? Arguably.

But to want to see the back of chick-lit because you've read too many blurbs that feature a single girl with too many shoes and a Martini habit is a bit like consigning pop music to the knackers' yard just because you don't like *The X Factor*. Sorry, Damien Rice, Florence and the Machine, the Beatles – but I just hated Diva Fever's rendition of "I Will Survive", so I'm glad to see the back of you.

ED I suppose my problem with chick-lit is not the books it describes, but the term itself. I don't want to get rid of the books; just the irritating label. Why is it necessary to perpetuate this notion that women need a special kind of literature that isn't too taxing for their pretty little heads? Or that female authors – and it is only ever female authors – need to be packaged in a certain way in order to sell? I loved *Bridget Jones's Diary* and *I Don't Know How She Does It* when they first came out because they were witty, insightful and genuinely subversive. They were saying things that hadn't

been said before and tapping into something a lot of women felt but hadn't necessarily expressed. In the case of *Bridget Jones*, it was the social malaise of the thirtysomething singleton, surrounded by smug marrieds and inappropriate men. In the case of *IDKHSDI*, it was the harried life of a working mother trying to balance it all.

But sometimes great parents have awful children. These two themes have now been done to death by wave upon wave of inferior writers trying to capitalise on the original success. They have become their own cliche. I'm not sure I'm comfortable either with the idea of "women writing for other women". As a female author, I think I write for other people. Of course, my main characters might be women and they might go through a series of emotional journeys, but that doesn't mean men shouldn't read these books too. But they're not likely to do so if it has a pink cover and is placed in the chick-lit section of the bookstore. As you rightly point out, no one said David Nicholls's *One Day* was chick-lit. Why not? Because it was written by a man.

TP Let's be honest – there was never anything particularly new about chick-lit, anyway. *Bridget Jones* might have felt fresh and funny but Helen Fielding wasn't doing anything that Jane Austen, Nancy Mitford or Stella Gibbons weren't doing decades earlier. But to dismiss everything that has followed on from *Bridget Jones* as a cliche is to write off some fantastic books that bring a lot of pleasure to a lot of readers. Jennifer Weiner and Melissa Bank are just two authors who write smart and thoughtful books but are probably categorised as chick-lit just because they write about real heroines with real problems and have book jackets that have at some point featured the colour pink. How are they supposed to be packaged – with gothic font and a knife on the front cover dripping with blood?

And what's wrong with writing books that are aimed squarely at a female audience? I don't notice Wilbur Smith or Andy McNab being lambasted for writing for a mainly male readership and being packaged that way.

If there's a problem here it's about the word "chick". Somewhere along the line chick-lit was probably a fun, easy-to-digest marketing slogan but it now seems to be an all-encompassing slur to lots of warm, witty and wonderfully written books. Perhaps some clever book executive somewhere needs to come up with a new moniker for a range of novels that examine a whole spectrum of topics, from media law to marital breakdown. But until that happens don't fear the pink. Embrace it. Somewhere behind a soft-focus cover could be a book that might not change your life but will give you several pleasurable hours escaping from it.

ED Yes, I agree. Let's get rid of the "chick" in lit. I've never liked being compared to a small, freshly hatched bird in any case. It's a wholly unnecessary pigeonhole (to continue the feathered terminology).

http://www.guardian.co.uk/commentisfree/2011/oct/02/death-of-chick-lit-debate?CMP=twt_gu

Wireless network can watch your breathing

- 16:08 27 September 2011 by **Melissae Fellet**

Watched over wirelessly *(Image: Alex Bramwell/Getty)*

It's not easy sleeping with tubes up your nose, but when doctors want to monitor a person's breathing they have few other choices. A new wireless system promises to do away with intrusive medical technology – but instead it might end up being used as a surveillance tool to track people's movements and activities behind closed doors.

While testing some new equipment, Neal Patwari of the University of Utah in Salt Lake City and colleagues noticed variations in wireless signal strength triggered by a person's breathing, but only at certain locations around the room. So they set up an experiment to test whether a wireless network could reliably measure breathing rate.

In the test, Patwari lay in a hospital bed surrounded by 20 inexpensive, off-the-shelf wireless units. These were arrayed so that they sent 2.4 gigahertz radio waves across the bed – the same frequency as Wi-Fi – but with one-thousandth the power of a laptop's wireless card. The units measured the signal strength four times a second – fast enough to measure fluctuations caused by individual breaths.

After collecting 30 seconds of data, the network was able to accurately estimate a person's breathing rate to within 0.4 breaths per minute.

Patwari concludes that the wireless signals bent around his chest as it rose with each inhalation, causing them to travel a longer distance and decrease slightly in power.

Unmasking

The technology could allow people to rest more comfortably during sleep studies, Patwari says, without being connected to machines by wires and tubes. He contends that the system could be used to augment current medical tests for lung capacity, too.

But current medical breathing monitoring methods are more than adequate, says Salvatore Morgera at the University of South Florida in Tampa. These methods also measure the amount of carbon dioxide in exhaled gases, collected in a mask or a tiny tube in each nostril, whereas wireless monitoring would just increase the clutter of radio waves in a modern hospital.

If it doesn't find a use in medicine, the device may still interest snoopers. In a previous study, Patwari and a colleague showed that because radio signals at Wi-Fi frequencies can penetrate walls, a wireless network set up outside a home could track people as they move from room to room. With this new level of precision, a system tailored for surveillance could spy on people as they move around a hotel room, for example, or even discern whether they are resting on a couch or in bed.

Journal reference: arxiv.org/1109.3898

http://www.newscientist.com/article/dn20971-wireless-network-can-watch-your-breathing.html?full=true&print=true

Servants in the twentieth century

Alison Light

Lucy Delap
KNOWING THEIR PLACE
Domestic service in twentieth-century Britain
260pp. Oxford University Press. £65 (US $125).
978 0 19 957294 6

Published: 28 September 2011

Domestic servants circa 1900

M y grandmother never had a good word to say for service; nor did her oldest daughter, Winnie. The former had worked as a kitchenmaid or "skivvy" in a big house in Carshalton, Surrey, while my aunt had been a general servant in a suburban house and then in a posh bed and breakfast in Southsea on the Hampshire coast. At thirteen, my grandmother had gone straight into service from the workhouse children's home. My aunt, a year older, finished school on a Friday and started her job, thanks to her father, the following Monday. Neither had any say in the matter. Long hours, a lot of drudgery, very poor pay, and almost no time off; domestic service was the only option.

Although one was born in 1897 and the other in 1920, their experiences appear very similar and their story seamless. But, as Lucy Delap argues, domestic service changed enormously in the twentieth century. After the First World War, a new generation expected more of their employers; living-in was on the wane; some kinds of work, nannying in particular, became professionalized, and there were gradually fewer rituals of deference and servility. Women and girls frequently chose service as a training in housekeeping skills; some relished the better accommodation and what they felt was a finer way of life: "like going from the pigsty into the palace", was Grace Cooper's view, coming to work in London from South Wales. Even the most isolated or dependent

of situations could paradoxically encourage independence and self-respect: money sent home enhanced the family budget; savings could be spent on the latest hat or just a bag of sweets. Service did not automatically cut you off from your class. Plenty of women stayed in their own neighbourhoods, worked in houses not unlike their own, and sat down to eat with their employers. If domestic service remained the most common "entry-level" job for women until the Second World War, it was not the only destination for poor British girls. Indeed, none of my grandmother's other four daughters, all born before 1939, became domestics. They found jobs in factories and offices, cinemas and shops.

There were gradually fewer rituals of deference and servility Knowing Their Place is an ambitious study, which corrects a number of easy assumptions. It is a broadly cultural survey, moving across the generations, arguing that servant-keeping was "reworked rather than discarded", even in the so-called "servantless home", and that it has stayed as a feature of post-industrial society. Delap outlines a number of ways of thinking about the service relationship as an emotional territory as well as an economic relation. As a "foundational narrative" for the British, shoring up their sense of themselves, it is forged as much by the servants themselves, a "site for selffashioning".

Amid much riveting detail, she scans advice manuals, government reports, letters, court cases, trade union records, newspapers and a wide tranche of newspapers and periodicals. A chapter on "kitchen-sink" humour shows how servants could have their say in music hall songs, jokes and comic papers. Patsy Pancake, The Comical Cook regularly "getting one over" on her mistress in Comic Cuts, or the exploits of Mrs Sudds, the hapless char in Picture Fun, are particularly happy finds. Equally suggestive is the chapter on pornography. Some Victorians took pleasure in gazing at the tabooed body of the servant, fascinated by working-class courtship; later generations, Delap maintains, were stirred more by nostalgic or parodic "Victoriana" scenarios of maids and masters (or mistresses) saucily engaged in cross-class seduction.

Service, Delap argues, is now an "over-represented" place in cultural memory, a continual source of popular entertainment and an abiding element of the heritage industry. The 1980s saw a boom in private domestic employment as more of the "cash rich, time poor" turned to cleaners, au pairs, child minders, and gardeners; service is still most likely to be a "fall-back" occupation or a "toe-hold" job for migrants; cleaning is still at the bottom of the wage scale. Meanwhile, domestic service is glamorously restaged in film and television, and in "heritage performances" in country houses, as belonging resolutely to the past.

Delap interviews a number of curators about the semi-comic, generic treatment of the staff in on-site re-enactments where visitors are invited to listen to servant banter, try out a flatiron or a mangle. Such "live interpretations" are usually one-sided. As one employee at a great house put it, "we don't really do the upstairs". Another agrees it would be tricky: "you've got your upper class people and the details would have to be . . . really spot on".

Domestic service still barely registers in studies of twentieth-century Britain Delap draws on a rich repertoire of memoirs, oral histories and interviews. The human voices are always beguiling but their variety can be problematic. The extracts often illustrate contradictory points and can support sweeping generalization: "mothers in the twentieth century were by and large supportive of their daughters' aspirations". Delap is alert to the untrustworthy nature of oral testimony but ends up taking much of it at face value.

We can't judge for ourselves since no one story or interview is given in full (and we learn nothing about Delap's own practice when she asks the questions). Did Miss Gearl, a former London tweeny "thrilled at the idea of wearing long print dresses and a mob cap" in her first job, stay thrilled? We hear no more about her. Without a fuller account of their inner lives, hardly any of Delap's servants or their employers stay in the memory or emerge as individuals.

They become texts to be sampled. (Ronald Fraser's memoir, In Search of a Past, which explored the part servants played in his psychological development, is a telling absence.) Knowing Their Place contains

wonderful material and much insight, but no argument predominates. Its impulse is revisionist, wanting to move us beyond "the somewhat sterile debate about whether service was a good or a bad thing". This is premature, I think. Domestic service still barely registers in studies of twentieth-century Britain. But Lucy Delap's study will certainly make it harder to ignore.

Alison Light is a Visiting Professor in the School of English at the University of Newcastle and the author of Mrs Woolf and the Servants, 2007. She is writing a book on the history of the English working class.

http://www.the-tls.co.uk/tls/public/article785837.ece

Falcon rockets to land on their toes

20:59 30 September 2011

Henry Spencer, spaceflight commentator

Approaching touchdown (Image: SpaceX)

Private space firm SpaceX has revised its plan for making its Falcon rockets reusable.

Today, when a Falcon puts a payload into orbit, all the hardware that makes the delivery is then thrown away. This is obviously an expensive way to do things; it's traditional in the launch business, but that doesn't make it a good idea. SpaceX has long been interested in doing things differently, and now they finally seem to have adopted a reasonable approach.

This isn't a new idea for them. Since SpaceX's very beginnings, they have talked about recovering and reusing at least the first stages of their rockets. What's been conspicuously lacking is any visible progress toward that. Now this might change.

Although the announcement naturally emphasised the new plan and its exciting potential, the other side of this is a confession of failure: SpaceX's original concept for first-stage recovery and reuse didn't work and apparently is being abandoned.

The original concept *seemed* simple: the spent first stage would parachute down to a splashdown offshore, where it would be recovered by boat and hauled back to shore for refurbishment and reuse. There were some obvious questions about how well a rocket stage would survive being soaked in seawater, which is quite corrosive; perhaps only selected components would be reusable, not the whole stage. (Yes, NASA recovered the shuttle SRBs the same way, but their refurbishment process was so labour-intensive that it's not clear it ever really saved them any money.)

Overall, the idea seemed like a clumsy makeshift, and some doubted that there would be much real benefit, but it didn't seem ridiculous – just challenging.

The only problem was, it didn't work. At the Space Access conference in April, Gwynne Shotwell, SpaceX's president, admitted: "We have recovered *pieces* of the first stages." The first stages weren't even getting as far as deploying their parachutes – they were breaking up during atmospheric re-entry.

So it was back to the drawing board for SpaceX. And the new plan actually seems much more promising. After the upper stages separate from it, the nearly-empty first stage will reignite some of its engines to turn around and come back to its launch site, and will then land vertically on rocket power, like the experimental DC-X and the private rockets competing in NASA's Lunar Lander Challenge. In due time, SpaceX aims to have the second stage also re-enter behind a heat shield on its nose, and do the same vertical rocket landing.

Watch an animation of SpaceX's planned vertical landings

This method might *seem* more complicated than the old one, but parachutes and splashdowns are not as simple as they might look, and this way the landing will be gentler and much more controlled... and on dry land, too. There will be some challenges along the way, but the final result should be much more satisfactory.

The biggest near-term advantage won't even be the reuse of the expensive hardware, but something less obvious: the ability to flight-test it. No matter how carefully SpaceX builds its rockets today, each one is always flying for the very first time. This isn't nearly as good as being able to test each and every one repeatedly, to find and fix any problems *before* a rocket is entrusted with an expensive payload. Development of the new system should also be easier, because each new stage can start with short "bunny hop" tests and gradually work up to higher and faster flights, rather than having to do the full flight the first time.

All this probably won't be quite as straightforward as SpaceX hopes. They'll probably discover that turning expendable stages into reusable vehicles requires more than just a few small modifications. But SpaceX is hoping to be around for the long haul – aiming to ferry astronauts to the International Space Station in the near term and on to Mars in a decade or two – and in that case, it's well worth taking the extra trouble now.

Henry Spencer is a computer programmer, spacecraft engineer and amateur space historian

http://www.newscientist.com/blogs/shortsharpscience/2011/09/falcon-rockets-to-land-on-thei.html

The Needs of the Occupy Wall Street Library

Posted: 30 Sep 2011 11:21 AM PDT

Welcome to the newest branch in the New York City public library system; The Liberty Square Library. The library serves the Occupy Wall Street community and is open 24hrs a day.
And like most libraries these days it is in serious need of support.

In an update to BP's previous post on the library I added mention of the piece on The Book Bench, the book blog of *The New Yorker*, in which Alexia Nadar paid a visit to the library and spoke with the "appointed caretaker," Betty Fagin.

To be clear, Fagin is a librarian who "stepped forward to take responsibility for the library." She is neither appointed or anointed. She is a volunteer who travels from her home in Brooklyn every day, she is also a mother which requires her to go home each night. She is a true hero. And she needs help!

First and foremost, more volunteers are needed to maintain and care for the library. This is a 24/7 event and hence requires round the clock support.

In addition Fagin states:

One of the biggest challenges right now is just keeping the books dry--we had a lot of heavy rain last night & I'm a bit scared of what I'll find when I get there this morning. At the moment, we're just covering everything with tarps and garbage bags when rain threatens.

You asked about the library's needs. They change daily, but book donations have been pouring in-- keeping up with what we have and creating order is a challenge. Our biggest need is for more help. We would love to have more books in languages other than English, board games have been very popular (risk would be nice, another chess set or two) and book repair supplies (I've done some things with duct tape I'm not proud of). I dream of those big plastic containers with lids that are water tight.

So now it's up to us.

Here are two Twitter hashtags that can help the process: #occupywallstreetlibrary #libertysquarelibrary

As needs arise they can be posted and hopefully fulfilled. I have personally pledged some immediate financial support to address some of the most pressing needs. If you are not in the NYC region and would like to donate some of the requested items please email me at michael@bookpatrol.net and I will try and facilitate as best I can.

http://feedproxy.google.com/~r/BookPatrol/~3/TbIvkOQj9kE/needs-of-occupy-wall-street-library.html?utm_source=feedburner&utm_medium=email

It's already happened

James Meek

Wrightington Hospital, in the countryside near Wigan, is an accretion of postwar buildings of different eras clustered round an 18th-century mansion. It was sold to Lancashire County Council in 1920 after the death of its last resident, a spendthrift, according to one writer, 'with a fanatical attachment to blood sports'. The hospital promotes itself as 'a centre of orthopaedic excellence'. National Health Service hospitals have to promote themselves these days. Earlier this year it survived a brush with closure. It's neat and scrubbed and slightly worn at the edges, unable to justify to itself that few per cent of the budget the private sector sets aside for corporate sheen, although it does have a museum dedicated to John Charnley, who, almost half a century ago, pioneered the popular benchmark of the NHS's success or failure, the hip replacement operation.

They still do hips at Wrightington, and knees, and elbows, and shoulders. They deal with joint problems that are too tricky for general hospitals. There's a sort of blazer and brogues testosterone in the corridors, where the surgeons have a habit of cuffing one another's faces affectionately. At the end of a hallway lined with untidy stacks of case notes in wrinkled cardboard folders Martyn Porter, a senior surgeon and the hospital's clinical chairman, waited in his office to be called to the operating theatre. He fixed me with an intense, tired, humorous gaze. 'The problem with politicians is they can't be honest,' he said. 'If they said, "We're going to privatise the NHS," they'd be kicked out the next day.'

The Conservative Party's 2010 manifesto promised: 'We are stopping the top-down reconfigurations of NHS services, imposed from Whitehall.' Two months later, the new health secretary, the Conservative Andrew Lansley, announced his plans for a top-down reconfiguration of England's NHS services, imposed from Whitehall.

The patient whom Porter was about to operate on was a 60-year-old woman from the Wirral with a complex prosthesis in one leg, running from her knee to her hip. She'd had a fracture and Porter had had a special device made at a workshop in another part of the NHS, the Royal National Orthopaedic Hospital in Stanmore in Middlesex. The idea was for the device to slide over the femoral spur of the knee joint, essentially replacing her whole leg down to the ankle. 'The case we're doing this morning, we're going to make a loss of about £5000. The private sector wouldn't do it,' he said. 'How do we deal with that? Some procedures the ebitda is about 8 per cent. If you make an ebitda of 12 per cent you're making a real profit.' You expect medical jargon from surgeons, but I was surprised to hear the word 'ebitda' from Porter. It's an accountancy term meaning 'earnings before interest, taxation, depreciation and amortisation'.

'Last year we did about 1400 hip replacements,' he said. 'The worrying thing for us is we lost a million pounds doing that. What we worked out is that our length of stay' – the time patients spend in hospital after an operation – 'was six days. If we can get it down to five days we break even and if it's four, we make a million pound profit.'

I felt as if I'd somehow jumped forwards in time. Lansley has not yet, supposedly, shaken up the NHS. He'd barely been in power a year when I talked to Porter. But here was a leading surgeon in an NHS hospital, about to perform a challenging operation on an NHS patient, telling me exactly how much money the hospital was going to lose by operating on her, and chatting easily about profit and loss, as if he'd been living in Lansleyworld for years. Had the NHS been privatised one day while I was sleeping?

When the NHS was created in 1948, it had three core principles. It was to be universal: anyone and everyone would receive medical treatment whenever they needed it. It was to be comprehensive, covering all forms of healthcare, from dentistry to cancer. And it was to be 'free at the point of delivery': no matter how much the system cost to run, no matter how much or how little any individual had contributed to those costs, no matter how expensive their treatment or how many times they went to the doctor, they'd never be billed for it.

Through dozens of reorganisations since then, including the present one, these principles have remained, along with another: that it's never a bad time for a fresh reorganisation. Otherwise, much has changed.

The source of the money that funds the NHS is still, as in 1948, general taxation, and there are no plans to change this. For the first 30 years, civil servants in Whitehall and the regions doled out annual budgets to hospitals and GPs according to the size of the populations they served and an estimate of the scale of their health problems. Money flowed down from the Treasury, but it didn't flow horizontally between the different parts of the NHS. Each element got its overall allowance, paid its staff, obtained its equipment and supplies, and co-operated, sometimes well, sometimes not, with the other elements, according to an overarching plan. The aim was fairness, an even spread of care across the country. In a monopoly healthcare system, competition had no place; on the contrary, it seemed sensible to the planners to avoid duplication of services. It was patriarchal and democratic, innovative and hidebound, cumbersome and cheap. For the majority without private insurance, if you were ill, you knew you'd always be cared for; if you were cared for carelessly, you had nowhere else to go.

It's objectively hard to describe how money flows through the NHS now. The 'now' of the time of writing is not the 'now' of two weeks hence. In England – Scotland, Wales and Northern Ireland have gone along divergent health paths – the various parts of the NHS had already begun altering or abolishing themselves in response to the reorganisation announced last year when the reorganisation itself was reorganised. Nonetheless, it still functions, halfway between the system it was and the system Lansley wants it to be. The way it works, crudely speaking, is this. Every so often – it may be every year, or every two or three – the Department of Health is asked to make its pitch to the Treasury for the amount of money it thinks it should get from the overall tax pot, and then is told how much it will actually get. Most of the money comes from general taxation – income tax, VAT, corporation tax, duties on booze and tobacco – but a proportion comes directly from National Insurance, a vitiated form of the link between NI and the Welfare State that its architects intended. In the most recent spending round Health got £101.5 billion for next year, a slight increase. Most of it – £89 billion – will be divided up between about 150 local agencies called Primary Care Trusts, or PCTs, spread around the country. PCTs act as the 'commissioners' of health services, ordering a community's medical care from hospitals, GPs and mental health professionals and paying them accordingly.

PCTs can use NHS money to commission care from the private sector. They're under no obligation to shop locally, either. The fact that NHS patients are now allowed to choose private or far-away hospitals for treatment means the PCTs are obliged to commission from them. NHS hospitals like Wrightington have become dependent for their financial viability on the money they make from selling their services to the PCTs. Competition already exists.

The amount of money that PCTs get from the government varies. The Department of Health has a panel of civil servants and academics called the Advisory Committee on Resource Allocation, Acra, which comes up with a formula for working out the health needs of each area – population size and density, the proportion of elderly people, life expectancy, the degree to which their health varies from the norm. In the poorer parts of Merseyside, for instance, where male life expectancy is 67, men can expect to be incapacitated by disability of some kind at the age of 44. The corresponding figures for the richer parts of West London are 89 and 74. The variation in the sums different PCTs get relative to their population is, accordingly, considerable. This year South Gloucestershire will receive £1298 per head, Islington in London £2268.

Primary Care Trusts were set up in 2002, but they're on the brink of abolition already. If Lansley and the coalition prevail, the way money flows through the NHS will look different again in a few years' time. It will still come from general taxation, but the money that now goes to the PCTs will be doled out instead by a new organisation, the NHS Commissioning Board, to bodies called Clinical Commissioning Groups, essentially clusters of GP practices. Across England, groups of family doctors will suddenly become responsible for handling tens of billions of pounds of public money, using it to commission most of the medical care NHS

patients receive, from major surgery to simple diagnostic tests. It is anticipated that, lacking expertise of their own, many will pay private contractors to manage these funds for them.

By that time a series of other changes will have made 'commission' more of a euphemism for 'buy'. At the moment, not everything a PCT commissions comes with a price tag. But within a few years almost all procedures, even those as seemingly amorphous and complex as caring for the mentally ill, will come in quantified, priced units. At the moment, hospitals aren't allowed to compete with each other on price, and are rewarded with extra money from the commissioners if they do a particularly good job. Procedures are categorised as 'healthcare resource groups', each with a code and a price. Any hospital anywhere in England, NHS or private, that carried out procedure HA11C on an NHS patient last year – treatment of a routine hip fracture – got a base payment of £8928 from the outfit that commissioned it, and £9373 if it followed 'best practice'. A maternity unit clocks £1324 for a regular birth, NZ01B; putting in an artificial heart, EA43Z, earns £33,531. But this isn't the amount they actually get. The sum is adjusted according to a local 'market forces factor', which takes account of the variation in cost of labour and assets between different areas. The codes and prices are worked out, in turn, according to the actions taken and materials used by typical hospitals. The set tariff for treating a stroke might be calculated from the price of nine days being nursed in a ward at £170 a day, a couple of X-rays at £20 each, ten pathology tests at £6 each and six sessions of therapy for £235 – a total of £1865. If the hospital can treat the patient for £1600, it keeps the difference. The incentive to send the patient home as soon as possible is high.

Under the new system, state money will 'follow the patient' wherever the patient chooses to take it, even when that is outside the NHS. Patients with chronic conditions like diabetes will increasingly be given, not treatment, but money to spend on treatment. All NHS hospitals will be obliged to become 'foundation trusts', turning them into semi-commercial operations, able to borrow money, set up joint ventures with private companies, merge with other hospitals – and go broke. The contracts they make with GP groups will be legally binding. They will find themselves competing not only with other NHS hospitals and private hospitals but potentially with the GP groups themselves, which may set up local clinics to provide diagnostic tests or minor surgery. Alongside the NHS Commissioning Board two other quangos will supervise the new competitive marketplace: the Care Quality Commission, there to make sure the players in the new marketplace don't harm patients, and Monitor, which, among other duties, will make sure that if a hospital goes bust somebody takes up the slack.

Lansley chose 19 July, the day Rupert and James Murdoch had the media transfixed with their testimony to the Culture Select Committee, to let slip that from next April a billion pounds' worth of NHS services, including wheelchair services for children and 'talking therapies' for people suffering from mild depression, anxiety or behavioural awkwardnesses like obsessive compulsive disorder, will be opened up to competitive bids from the private sector. The doctor and *Daily Telegraph* blogger Max Pemberton described it as 'the day they signed the death warrant for the NHS'. Throughout the latest debate on the Health Service's future, the Conservatives have praised it as an abstract concept, pledging to uphold 'an NHS that is free at the point of use and available to everyone based on need, not the ability to pay'. But it is quite possible to praise something even as you legislate it out of existence. Changes do not need to be advertised as embodying a cumulative destructive purpose for that purpose to be achieved. The fall of the Roman Empire was never announced, yet its fate was sealed once its rulers, no doubt for reasons of efficiency, introduced a choice of competing barbarians to defend its borders.

In their book *The Plot against the NHS*, Colin Leys and Stewart Player argue that, having failed to persuade the public and the medical establishment under Margaret Thatcher that the NHS should be turned into a European-style national insurance programme, the advocates of a competitive health market gave up trying to convince the big audience and focused on infiltrating Whitehall's policymaking centres and the think tanks.[*] As a result the government and the cast Leys and Player call 'marketeers' – private companies, lobbyists, pro-market think tankers – publicly praise the NHS, while taking incremental steps to turn it into an NHS in name only: a kitemark, as one prominent marketeer puts it in the book.

Yet there was a huge gap between the end of John Major's administration in 1997 and last year's Tory-Liberal pact. Labour, the party that created the NHS, which has pledged to defend it and has denounced the Lansley reforms, was in power for those 13 years. So how did a surgeon like Martyn Porter end up, in 2011, so accustomed to the world of commercial competition and the bottom line? In fact, as Leys and Player show, it was the governments of Tony Blair and Gordon Brown that began replacing the public components of the NHS with private ones, the effect concealed by large spending increases, long before Lansley and Cameron took charge. If the Conservatives and their Liberal allies are dismantling the NHS, it was Labour that loosened the screws.

The first attempt to introduce market competition into the NHS was made by Kenneth Clarke in 1990, in the dying months of Thatcher's rule. The 'internal market' was rushed in, ignoring the views of the medical profession. It didn't work. Tony Blair's first health minister, Frank Dobson, read its funeral rites when Labour came to power seven years later. Yet at the turn of the millennium, Alan Milburn replaced Dobson and Labour introduced a new, more radical version of that market.

It was Labour that introduced foundation trusts, allowing hospital managers to borrow money and making it possible for state hospitals to go broke. It was Labour that brought in the embryonic commercial health regulator Monitor. It was Labour that introduced 'Choose and Book', obliging patients to pick from a menu of NHS and private clinics when they needed to see a consultant. It was Labour that handed over millions of pounds to private companies to run specialist clinics that would treat NHS patients in the name of reducing waiting lists for procedures like hip operations. It was Labour that brought private firms in to advise regional NHS managers in the new business of commissioning. And it was Labour that began putting a national tariff on each procedure.

The more closely one looks at what has happened over the last 25 years, the more clearly one can perceive a consistent programme for commercialising the NHS that is independent of party political platforms: a purposeful leviathan of ideas that powers on steadily beneath the surface bickering of the political cycle, never changing course.

A key source of those ideas was Alain Enthoven, an American economist. Enthoven spent most of the 1960s in the Pentagon, one of the cerebral 'whizz kids' on the staff of the defence secretary Robert McNamara. McNamara was a wonk, confident that no mystery could withstand statistical analysis, and Enthoven was the chief wonk's wonk, crunching numbers to judge whether the new weapons the generals wanted were worth it. In 1973, Enthoven reinvented himself as an expert in the economics of healthcare. He believed the US health system, as a whole, was a failure (he described tax relief for private health insurance as a disaster), but thought one part of it, a California-based outfit called Kaiser Permanente, was exemplary. His ideal was something called 'managed competition', and in 1985 he wrote a paper for the Nuffield Trust suggesting it could work for the NHS.

Enthoven himself seems to have been taken aback by the speed with which Thatcher's sunset coterie latched onto him. In an interview with the *British Medical Journal* in 1989 he said of the Conservative proposals: 'I was very surprised by the lack of detail … I thought that I was throwing out a general idea that needed to be developed.' It is eerie to read the interview now. Everything that Enthoven prescribed then was either brought in by New Labour or is being put in place by Labour's supposed opponents a generation later. 'I recommended that the district health authorities be recast as purchasers of services on behalf of the populations they serve, with choice of where and from whom they buy the services, rather than being cast as monopoly suppliers' – check. 'Another very strong idea is that money follows patients' – check. 'Pay hospitals prospectively by diagnosis-related groups as our Medicare programme does' – check. 'Self-governing NHS trusts' – check.

What seems to have happened since 1985 is that Enthoven's ideas have become embedded in individual careers, financial aspirations and personal relationships independently of the rise and fall of parties. For

individuals, there is money to be made by promoting the market. In 2006, *Accountancy Age* reported that the NHS was spending more on consultants than all Britain's manufacturers put together. The figure for 2007-08 was £308.5 million. The post-political careers of the Labour cabinet ministers responsible for marketising the NHS don't make for comfortable reading. Alan Milburn became an adviser to Bridgepoint Capital, a venture capital firm backing private health companies in Britain, and to the crisps and fizzy drinks maker PepsiCo; for 18 days a year advising Cinven, which owns 37 private hospitals, Patricia Hewitt, one of Milburn's successors as health secretary, was paid £60,000. The revolving door has become a blur. Simon Stevens, Blair's special adviser on health, is now an executive vice president at UnitedHealth, one of America's largest private health companies. Mark Britnell, a career NHS manager who rose to become one of the most powerful civil servants in the department, upped sticks in 2009 to become global head of health for the consultants KPMG.

This last move did have the advantage of giving an insight into what had actually been going on in Whitehall and Downing Street. In 2010 Britnell was interviewed for a brochure put out by Apax Partners, a private equity firm: it had organised a conference in New York on how private companies could take advantage of the vulnerability of healthcare systems in a harsh financial climate. 'In future,' Britnell said, 'the NHS will be a state insurance provider, not a state deliverer … The NHS will be shown no mercy and the best time to take advantage of this will be in the next couple of years.' Responding later to the dismay his comments had caused, Britnell said in an article for the *Health Service Journal* that the NHS had saved his life in the year he left government service, that he would always support it, and that the quotes attributed to him 'do not reflect the discussion that took place' at the conference. But he didn't deny making the comments. 'Competition,' he added, 'can exist without privatisation.'

Yet Britnell had topped his own 'no mercy' line in an article he'd written for the same magazine the previous week. There he made the unremarkable if contentious point that 'all over the world, the size of the state has been increasing.' What furrowed the brow was the base year he chose for the comparison with today's level of public spending: the year was 1870, when infant mortality in Britain ran at 16 per cent, working-class men had just been given the vote, and four years had passed since a cholera epidemic killed 3500 Londoners.

Critics of the NHS often cite Enthoven's favourite health organisation, Kaiser Permanente, as a model for efficient, integrated care. And yet from the British point of view Kaiser stands out among American providers not because it's better or worse than the NHS but because it looks a bit like it. It's huge: it provides medical care to a mainly Californian membership roughly the size of the population of Austria. Its doctors are salaried and its hospitals are non-profit. It offers patients a complete service of hospitals, labs and family doctors, as the NHS does, although it also has its own pharmacies. And one explanation for its efficiency, as with the NHS until a few years ago, is that it actually limits choice. Most Kaiser members have a health plan that offers them or their employers relatively low premiums in exchange for using only Kaiser facilities.

It would be hard for a genuinely state-funded National Health Service to be as efficient as Kaiser Permanente because the NHS offers treatment to everyone, including the long-term unemployed and people with the rarest, most expensive conditions. Although it has a big charity programme, Kaiser only offers full, guaranteed care to those (85 per cent of the US population) covered by some form of insurance – the employed, those well-off enough to pay the premiums independently, and the over-65s who are covered by Medicare.

Kaiser is doing a lot right. Its model of 'integrated care' – where a single health organisation looks out for people not just during treatment but before, after and between, and hospital admission is seen as a failure – has long been a goal for progressives in the NHS. It seems to have done a better job than the NHS of getting medical information off paper and into computers. A 2003 study in the *British Medical Journal*, investigating the length of time the over-65s spent in hospital, found that for hip replacements, British pensioners went home, on average, 12 and a half days after admission; Kaiser patients were home after four and a half. Kaiser doesn't tie its consultants to its 35 hospitals; those who deal with chronic conditions are as likely to be in its 455 medical centres, alongside family doctors.

Getting ideas from Kaiser is one thing (NHS lengths of stay in hospital have dropped since 2003); using it as a template is another. The major problem that militates against importing the Kaiser model to the NHS is money. England isn't the only country that has studied Kaiser. Earlier this year a Danish think tank, the Rockwool Foundation, reported on its investigations. Its team, led by Anne Frølich, found that Kaiser was better than the Danish health service at getting its constituent parts to work together, at getting patients to take responsibility for their own health and at preventing unnecessary hospital admissions. Everything was great, except that for every krone Denmark spent on healthcare, Kaiser spent one and a half. According to the latest OECD figures, Denmark outspends Britain on healthcare, head for head, by 25 per cent. On the basis of the Rockwool study, the Kaiser system could be reproduced in Britain only if health spending were increased by 87 per cent. That is not going to happen on any Tory or Labour planet in this galaxy.

The curious thing about the Lansley plan is that it is supposed to save money, yet despite the increase in spending on the NHS under Labour, the organisation remains a bargain. The two foreign systems with which it is most often compared, the American and the French, are more expensive, are coming to be seen as unaffordable in their own countries and contain elements that it would be hard for Britons to accept. Kaiser works well and is cheaper than traditional American healthcare. But it still reflects the US model. Most people over 65 are eligible for Medicare, a kind of gold-plated American NHS for the elderly, but otherwise, if you have no insurance – you don't have a job, you're too poor, you're gambling that you won't get sick – you have no guaranteed access to Kaiser's facilities. If you fall seriously ill in the US, aren't insured and aren't rich, you have two main options: to go to a hospital's accident and emergency unit, where they're obliged to treat you, or to try to get Medicaid, a government programme to help the poor and disadvantaged run on a state by state basis. But the hospital will charge the full rate for treating you, which it will then try to recover against any assets you have, while Medicaid is means-tested. In other words, being uninsured and having a serious car accident in the United States is hard to make compatible with owning a house. President Obama's healthcare reforms will make it easier to get Medicaid and will both compel and subsidise the earning uninsured to get insurance. But inequalities will remain.

If you're insured in America, you have access to some of the world's finest medical facilities, and if you have an employer to pick up most of the premium, it might seem to be a good deal. But just paying a premium each month doesn't make healthcare free at the point of delivery. Two standard features of US health insurance are the 'copay', a fee for consultations or drugs, and the 'deductible', an amount the patient is expected to pay before the insurance kicks in, like the excess on car insurance. The lower the premiums, the higher the copays and deductible. Kaiser's Copayment 25 Plan, for instance, costs $487 a month for a 48-year-old living in San Francisco; that's a high premium, and there's no deductible. But every time you see the doctor, you have to pay $25; an ambulance is $100, a month's supply of branded prescription drugs $35; you have to contribute $200 a day for a hospital stay, and so on up to a maximum of $2500 a year. At the other end of the scale, there's a plan that costs $169 a month. That's a bargain if you don't get sick or pregnant (maternity isn't covered.) But if you're ill, you have to pay the first $5000 out of your own pocket. After that the copays kick in – $50 to see the doctor, and for hospital treatment, 30 per cent of the actual cost – until you've forked out $7500. As for prescription drugs, you're on your own.

A Harvard-led study found that 62 per cent of all bankruptcies in the United States in 2007 were due to medical bills, an increase of 50 per cent in six years. Most of those affected were well-educated, middle-class homeowners. Astonishingly, three-quarters had had their finances destroyed by medical costs even though they had insurance. In a significant number of cases, it was paying to look after a sick child that bankrupted parents. Among the common ailments were neurological conditions like multiple sclerosis, which left households $34,000 out of pocket on average, diabetes ($26,000) and stroke ($23,000). Latest figures from the OECD and the World Health Organisation suggest that the US spends 2.4 times more on health per person than Britain, yet Britons live slightly longer, on average, than Americans. British men can expect to live to be 78, two years older than American men; for women it's 82 versus 81.

The US healthcare system is unique, as is the NHS. Most rich countries lie somewhere in between the two, using mandatory insurance, with a mixture of state, for-profit and non-profit medical organisations providing the care. France, for instance, spends slightly more on health than Britain, and French women, though not French men, live slightly longer. French people of working age, together with their employers if they have them, pay into a social security fund that's supposed to cover healthcare, pensions, disability and child support. The poorest French people get healthcare absolutely free under a system called Couverture Maladie Universelle, or CMU. There is also a list of 30 conditions, known as Affections Longue Durée, which are treated free of charge for everyone: cancer, HIV, diabetes, Parkinson's, all the way to leprosy. Otherwise the relatively well-off, though shielded from ruin by the sickness insurance system, Assurance Maladie, are faced with a system of copays not much less onerous than America's. Where in Britain copays are restricted to dentistry and prescription charges, in France patients pay a fee each time they visit the doctor. They pay a percentage, known as the *ticket modérateur*, of hospital costs, ambulance bills and medical procedures. Each visit to your GP, for instance, costs €23 up front, of which €15.10 will be reimbursed. A replacement hip is free, but to get one put in you have to pay 20 per cent of the cost of surgery, lab tests, consultants' fees and the stay in hospital.

The huge sums France spends giving its citizens free, universal access to the latest cancer drugs and equipment are popular, but the country's lavish spending on extreme illnesses doesn't put it as far ahead of Britain as critics of the NHS claim. One recent study led by Philippe Autier of the International Agency for Research on Cancer in Lyon showed that the number of people dying of breast cancer in England and Wales fell by 35 per cent between 1989 and 2006, against an 11 per cent fall in France. France is still doing slightly better than England but the rates have almost converged.

Britons who idealise the French system imagine that in France anyone can see any doctor they like and that the state will pick up the bill, but if this was ever true, it isn't true now. The country's social security fund is chronically in the red. To see a consultant inside the Assurance Maladie system, patients have to get a referral from a GP, as in Britain. And there are two kinds of doctor. Only *secteur 1* doctors charge the Assurance Maladie fee. *Secteur 2* doctors can set their own fees, but the share reimbursed by Assurance Maladie doesn't change. An increasing number are taking out private health insurance to cover the gap.

One dark Sunday afternoon in February 1982 Jill Charnley waited at the wheel of a car outside a hospital in Mansfield. Through the storm she saw her husband bustling towards her with a plastic pail containing the haunch of a woman who'd just died. 'Down the road he came with a triumphant smile on his face and this bucket with a hip in it. He put it in the boot of the car. I remember saying: "My God, I hope we don't have an accident, if they look in the boot of the car to see what's there …"'

John Charnley, Sir John as he was by then, managed to restrain himself from dissecting the specimen, preserved under formalin, until the next day. The dead patient's hip was, in a way, as much his as hers. It was implanted in 1963, one of the world's first successful total hip replacements, performed by Charnley using a hip of his own design. 'This is truly a marvellous climax to my series of more than 70 cases,' he wrote in his journal, referring to post-mortem examinations he'd already done on his early patients. To have his prototype hip work smoothly inside someone for almost 20 years and still be, as he described it, in perfect condition, gave him joy.

The first generation of NHS surgeons were front-line surgeons in a literal sense. In 1940, aged 29, Charnley went to France as a military medic with the makeshift flotilla evacuating British troops from Dunkirk. 'He didn't expect to survive,' his widow told me. 'The boat he was in was bombed or shelled. I remember him saying to me that was the point when he believed he'd been saved for a purpose.'

The foundation of the NHS in 1948 coincided with a golden era in the struggle against infectious disease. In postwar Britain, orthopaedic surgeons earned their spurs in hospitals built in the countryside as sanitoria, designed to deal with the bone and joint problems caused by tuberculosis and polio. But the incidence of these

infectious diseases was dropping. Casting around for new raisons d'être, the bone doctors fastened on arthritis.

Up to this point, the options for people with a dodgy hip were limited. Basic human actions – walking, getting up, sitting down – require smooth movement of the femoral head, the ball-like top of the thigh bone, against the cup-like socket in the pelvis known as the acetabulum. When it works as evolution made it, it is because socket and head are sheathed in a smooth layer of cartilage that secretes a natural lubricant called synovial fluid. Inflammation, fractures and swelling make the hip jam and chafe like a rusted-up hinge. The result is immobility and pain. By the 1950s, it was becoming fairly common to cut off the degraded top of a patient's thigh bone and replace the femoral head with one made of metal or ceramic. Other surgeons focused on the acetabulum: they lined damaged hip sockets with cups made of steel, chrome alloy or glass. What was missing was total hip replacement, a reliable way of replacing both head and socket. It had been tried in the 1930s, with the two parts made of metal, but it had never really worked.

Charnley charged at the problem with zeal. A grammar school boy from Bury, he was a charismatic dynamo, a brilliant explainer given to anger when thwarted. He was so obsessed with bone growth that he got a colleague to cut off a piece of his shin bone and regraft it, just to see what would happen. (He got an infection and needed another, more serious operation.) Imbued with technocratic patriotism he carried a torch for the British motor industry and saw parallels between car and human engineering. Jill Charnley remembers him roaring down to London in his Aston Martin – 'a brute of a car, a good engineering car' – to visit her. He told her he was redesigning nature, and illustrated his theories with ball bearings from the British Motor Corporation's new Mini.

They were married in 1957 and Jill moved into his medical digs in Manchester, where the wallpaper had a bone motif. Keen to avoid the communal dining-room, with its clientele of fusty bachelor surgeons, she tried the kitchenette. 'I went in and opened the first cupboard,' she said. 'I was literally showered with old bones and all sorts of screws and bits and pieces.'

Human bones?

'Oh Lord, yes.'

After noticing that a patient with a French-made acrylic ball fitted to the top of his thigh bone gave off a loud squeaking whenever he moved, Charnley realised that a complete hip replacement would work only when the head was firmly held in place and when materials were found that mimicked the low-friction, squeak-free movement of a natural hip joint.

His first attempt was a steel ball, smaller than the usual prostheses, attached to a dagger-like blade that was pushed through the soft core of the thigh bone and held in place with cement, like grout round a tile. For the socket, he used a Teflon cup. He put the experimental hip in about 300 patients. It was a disaster. After a few years tiny particles of Teflon shed by the cup caused a vile cheesy substance to build up around the joint. The blade came loose in the bone. Pain returned. Each one of the Teflon hips that Charnley had so laboriously put into his patients had to be removed and replaced. He did the work himself. His biographer, William Waugh, quotes one witness as saying the sight of Charnley going to each operation was 'like observing a monk pouring ashes over his own head'. Punishing himself further, Charnley went around for nine months with a lump of Teflon implanted in his thigh to observe its effects.

In May 1962 a salesman turned up at Wrightington trying to flog a new plastic from Germany, a kind of polyethylene, used for gears in the Lancashire textile mills. It proved many times more hard-wearing than Teflon. Only after implanting a chunk of polyethylene into his much-scarred legs and leaving it there for months was Charnley prepared to risk putting it in patients. It worked. The procedure was taken up around the world.

Now, each year, hip replacements free millions of people from pain and immobility. The operation has a success rate of about 95 per cent. It lacks the life-saving glamour of brain surgery, resuscitation of car-crash victims or new cancer drugs. It is something more remarkable, a radical and complex operation – involving the sawing of bones, the deep penetration of skin and muscle, extreme measures to prevent infection and the replacement of a vital body part with a synthetic device – that transforms the lives of its beneficiaries, yet has become routine.

Making artificial hips – and knees, and elbows, and shoulders – has become a multi-billion-pound global business. But it was in the austere conditions of an old TB hospital in Lancashire, in the state-run NHS, not in the well-funded, commercially competitive world of American medicine, that total hip replacement was pioneered. To make the first machine to mass produce polyethylene cups, Harry Craven, a young craftsman who worked for Charnley, scavenged odds and ends from a local scrapyard. In their book *A Transatlantic History of Total Hip Replacement* Julie Anderson, Francis Neary and John Pickstone argue that by putting surgeons on state salaries, the NHS freed them from dependence on private patients, giving the innovative among them the security to experiment.[†] Charnley was only the most successful of a string of British surgeon-inventors who designed effective hips in the 1960s and 1970s.

Born in the NHS, routine hip replacement, the small family car of medical procedures (the first Morris Minor went on show two months after the NHS began), became the marker of the Health Service's life stages. Stoical postwar patients, grateful to have their pain relieved and used to rationing and queues, gave way to a less accepting generation comfortable with the label 'consumer'. Charnley described his first patients as 'pitifully grateful' for the relief from pain his short-lived Teflon hips gave them. By the end of his life, he was ranting against the 'crass ignorance and stupidity' of Britain's consumerist 'peasants'.

People were living longer, so they were older for longer. Demand for the procedure rose faster than the number of surgeons and hospital facilities to carry it out. In 1982 a fifth of patients waiting for a hip replacement had been waiting a year or more. Supporters of the NHS pointed out, correctly, that the service wasn't getting enough money to satisfy patients, and was underfunded compared to its European peers; yet the huge waiting list for hip surgery, much greater than for any other procedure, was used by Thatcherites throughout the 1970s, 1980s and 1990s as evidence that the NHS was inefficient. When New Labour came in and hosed money at the problem, waiting times fell. But it was private companies, rather than the NHS, that picked up much of the extra work. Hip replacements, the life-enhancing procedure that came out of the Welfare State, became one of the main points of entry through which private health firms were undermining it.

Once you start writing about hip joints, you begin to notice the number of people hobbling and limping. Everywhere you look there seems to be an aluminium walking stick. On the train from Liverpool Lime Street to Birkenhead recently, I got into conversation with a couple of women in their forties who'd got onto the train with the help of sticks. One of them was waiting for a hip operation. The procedure was delayed longer than usual because she was trying to align two specialists. She couldn't get an orthopaedic surgeon to do her hip until she'd seen an endocrinologist to sort out another problem. I asked her whether she'd heard of the new centre in Runcorn specialising in joint replacements. Her eyes lit up: brand recognition. 'People tell me I should go there,' she said. I had to tell her that, only five years after opening, the Runcorn centre had just closed.

The costly fiasco of the Cheshire and Merseyside NHS Treatment Centre, to give the Runcorn clinic its proper name, was a typically post-Thatcherite episode. Governments now so idealise the private sector that just allowing private firms to compete isn't enough. New Labour believed it had to pay private companies to compete with their state rivals. The Runcorn clinic was one of a wave of 'independent sector treatment centres' – ISTCs – masterminded by a Texan private bureaucrat called Ken Anderson, recruited by the Department of Health in 2003 to shower private firms with gold in order to bring down NHS waiting lists.

A firm called Interhealth Canada was given a five-year contract to run the Runcorn ISTC, starting in 2006. It built a state of the art joint replacement clinic, designed and equipped to the highest standard, but it didn't have to pay for it: the entire £32 million cost was refunded by the taxpayer. In case this wasn't enough to keep the entrepreneurial tiger of Interhealth happy, the PCTs in Cheshire and Merseyside who were supposed to send NHS patients to the centre had to pay Interhealth 25 per cent more than the NHS rate to carry out the operations. If an operation went wrong, however, Interhealth wouldn't be expected to put it right. Initially, it wasn't asked to take any responsibility for training doctors either. The cherry on the cake was that it would be paid for a minimum number of procedures, no matter how many it carried out. Over five years, the firm happily accepted about £8 million for work it didn't do.

Once the five years were up, the PCTs decided they'd had enough, and told Interhealth its contract wouldn't be renewed. Earlier this year the centre's 165 staff were made redundant and the ISTC closed. The building reverted to NHS control. It hasn't been decided what will be done with it, but it'll probably be some kind of primary care clinic – 'like using a luxury hotel as a garage', Interhealth's boss, Fred Little, said to me bitterly, denouncing the NHS as a Soviet relic. According to a spokesman for the PCTs, Interhealth was offered a contract extension in 2009 provided it accepted the NHS rate for operations: it declined.

Dr Abhi Mantgani, a GP in Birkenhead, used to send patients to the Runcorn centre. It was 15 miles away but his practice laid on transport for patients. Mantgani didn't like it that local GPs weren't consulted before it was opened; nor does he like it that, just when patients were getting used to it, the place was shut down. 'The service at the ISTC was fantastic,' he said. 'Patients only had to go twice, first as outpatients for all the diagnostics, then they got a date for the operation and went in for surgery. Why can't NHS hospitals provide the same level of quality service?'

Dr Mantgani is a believer in the Milburn-Lansley continuum, and power is shifting to him. Page by page the websites of the PCTs that opened and closed the Runcorn ISTC are going dark. Health services on the Wirral peninsula will from 2013 be ordered up by three groups of general practitioners, and Mantgani is clinical leader of one of them. The Wirral Clinical Commissioning Group brings together 27 practices, covering 129,000 patients.

Born in India, Mantgani has been a GP in Birkenhead for 20 years. He is based in a smart new medical centre, light, bright and clean. Ambitious and articulate, he has an air of busyness and impatience with institutional inertia. He has been navigating local health politics for a long time. To GPs, patient choice is old hat already. He's eager to move on. Being able to choose a hospital isn't enough if you can't also choose a consultant. Having the power to commission a certain number of hip operations isn't enough, either. Mantgani wants to be able to commission 'packages of care': to get a hospital to assess a patient, take them in for surgery, make sure their home has any necessary adaptations and check on them regularly after the op, Kaiser-style. And he wants to get more tests out of hospitals into local clinics. 'Waiting six or eight weeks for an endoscopy is just not appropriate in a Western democracy,' he said. 'I think the NHS is a great system but I don't think it can remain the way it is … in vast parts of the country there is no proper choice and it is a cartel. And that leads to patients being given what clinicians think is the right thing to do. I'm not for wholescale creating this into some kind of private industry. But I think if various other models of working act as the grit in the oyster to stimulate better performance, better competition and choice for the patients, it's not a bad thing at all.'

There's no sign of a cartel in the Wirral. I punched the postcode for Dr Mantgani's surgery into the NHS Choices website, together with 'hip replacement'. Under the changes brought in by Labour, patients can choose from five hospitals within five miles and 59 within 50 miles. The closest is the Wirral's NHS hospital, Arrowe Park, three miles away; just across the Mersey is the Royal Liverpool University Hospital; the closest private hospital, the Spire Murrayfield, is only slightly further away. The site suggests you'd have to wait 11 weeks from referral to treatment at Arrowe Park, seven weeks at the Royal Liverpool and only five if you went to Spire. On the other hand, Spire doesn't have the full range of emergency services should something go wrong; nor is it likely to take difficult cases. If my hip was hurting like hell, I'm not sure I would want to

take these choices on myself. Why should I? Like most patients, I'm not a doctor. Dr Mantgani admitted: 'The patient often says: "You tell me where I should go."'

I got back on the train and went to Hoylake, on the western coast of the Wirral. At the ocean's edge an immense beach stretched out towards the horizon, where wind turbines seemed to scratch an eternal itch. In a chi-chi café I met John Smith, director of studies at Liverpool University Medical School, a shy, rather noble-looking man with shoulder-length grey hair. 'I'm not sure in many ways what choice means,' he said. 'Most patients might want to choose their consultant, but they want them to be in the local area, so actually choice isn't nearly as great as it might appear. As soon as you start introducing choice, you start introducing league tables, short-term targets and less of an overall pattern of healthcare. On the one hand, they want to say, "Let's have a market economy," but on the other they want to say: "Let's plan." Realistically, you can do one or the other reasonably well but you can't do both. As soon as you have freedom of choice the market will decide the outcome. Even when you give GPs budgets, what does the GP do if he gets several patients who demand very expensive treatments?'

Whomever I spoke to, and whatever they thought of the latest NHS upheaval, the conversation turned to the cruel paradox of the Health Service: the more successful it is in lengthening life, the more threatened it becomes. 'When the Health Service was started the average retirement age was 65, and life expectancy was 67,' Smith said. 'Much as I hate to say it, the issue of pensions is the issue that pervades the whole political affordability question. Unless people become surprisingly more productive, we are all going to have to work longer in order to maintain our standard of living. Someone is going to have to pick up the costs of looking after people who are being kept alive but whose ability to look after themselves is declining.'

To respect the NHS isn't to love it unconditionally. There can be few people who haven't experienced a moment of uncaringness or worse somewhere in the system. Monopolies, state or private, can get complacent, and can resist good changes; perhaps the general hospital is over-fetishised in this country. Yet past commercialisations and privatisations don't give confidence that a commercialisation-privatisation of the NHS would have a happy outcome. Competitive pressures can reduce choice as well as encourage it. You can give patients choice, but someone else chooses the choices. One of the things businesses do is merge and consolidate and already foundation trust hospitals are doing just that. In East London, for instance, five hospitals – Barts, the Royal London, Whipps Cross, Newham and the London Chest – are planning to merge. Merger or not, the London Chest is closing. But the rest are only a few miles apart. It seems unlikely they will all continue to offer all the services they now do after the merger. Foundation trusts often consist of more than one hospital, and one of the hidden implications of the Milburn-Lansley programme is that a strong, solvent, ambitious foundation trust has as much incentive to shut down one of its hospitals (in order to remain solvent and grow elsewhere) as a financially weak one.

The more for-profit companies become involved in the NHS, the more public money will leak out of the health system in the form of dividends. And the government is taking a risk. When it privatised the water industry, it effectively farmed out to the water companies the tax increases needed to pay for the renewal of the country's Victorian water infrastructure. When it privatised the electricity firms, it farmed out the tax increases needed to fund wind farms and new nuclear power stations. By commercialising the NHS, but promising to keep on paying for it, it doesn't leave room for manoeuvre in the health marketplace when competitors start encouraging patients to demand more expensive procedures.

In late June I visited Edward Atkins, a retired bank manager, at his home in East Molesey in Surrey. The modern redbrick bungalow where Atkins and his wife live is about 20 minutes' walk from Hampton Court station, long enough for me to appreciate the boon of properly functioning hips and knees. Atkins answered the door, a tall, solidly built man with a full head of hair who could easily pass for 65. In fact he's 80. He'd still be playing tennis if he could. As he describes it, much of his life seems to have run on rails, making all the stops and adhering to the timetable of respectable, decent, middle-class life in the comfier corners of postwar southern England. Born in Portsmouth, he did National Service, then got a job as a trainee at Lloyds.

He married, had children, got a mortgage, rose through the ranks and retired on an indexed pension at two-thirds of his final salary. His retirement began well. He played badminton, golf and tennis. Then, in his early seventies, he felt aches and pains in his right knee and groin. A cyst was removed from his knee, but he was told the knee was fine; perhaps the problem was his hip? In 2005, with the groin pain getting worse, Atkins, who has private insurance, went to see a consultant, Andrew Cobb.

Cobb, a distinguished orthopaedic surgeon doing a mix of private and NHS work, recommended a hip replacement of a new design called ASR, produced by the American company DePuy, a subsidiary of Johnson & Johnson. Apart from being more expensive, the ASR hip differed from the total hip replacement pioneered by John Charnley in two ways. Both surfaces, ball and cup, are made of cobalt-chromium – a so-called 'metal on metal' hip. And instead of cutting off the top of the thigh bone and pushing a spar deep inside the bone to hold the ball of the joint in place, the ball is a hollow hemisphere with a short stalk, like a mushroom, designed to cover the ball at the top of the femur rather than completely replace it. Hence the claim that the hip is not being replaced, merely 'resurfaced'.

Resurfacing means less bone is lost than in a full replacement. Even the most successful conventional hip replacements seldom last much beyond ten years, and it's easier and safer to put in a total hip replacement after a resurfacing than to put in one replacement after another. In other words, hip resurfacing is seen as ideal for the young and the active, people who are generally healthy and are likely to wear out at least one hip device. The DePuy ASR hip was marketed aggressively as a hip hip. A device with its origins in the basic need to eliminate pain and enable movement seemed to be entering the realm of lifestyle marketing.

Cobb pitched hard for the ASR hip, as Atkins remembers it, telling him the hip had 'just come out', that in a matter of six weeks he'd be playing golf again, even tennis. 'He said I wouldn't be able to play properly unless I had this operation.' But the clincher, for him, was a marketing video from DePuy showing a series of real people who were seemingly thriving with ASR hips. 'There was a golfer putting putts down from 25 yards. At the end there was this guy, apparently the coxswain of a West Country lifeboat, at the wheel of the actual lifeboat in very rough seas.'

What Atkins didn't know was that Cobb had helped design the hip he was promoting. Impressed by the video, he signed up for the operation. He was about to become a victim of what has been called 'one of the biggest disasters in orthopaedic history'. From the moment he went home, he felt something was wrong. 'All I know is my hip started clicking like mad after I got in a certain position. It was never really right.' The hip became inflamed, and the pain began. If he exerted himself – went out on his bike, for instance – his hip would swell up afterwards and start to hurt. He kept making appointments to see Cobb, who would reassure him. Atkins had already paid £2000 for the operation, the part of the £14,000 procedure his insurance wouldn't cover. But every time he went to see Cobb, he had to pay more than £200 for a consultation. In the end, on his GP's advice, he ambushed the surgeon at a walk-in NHS clinic he ran. Cobb agreed to replace his ASR hip with a regular, Charnley-style hip, using NHS money. By this time Atkins had been living with the pain for four years: 'Four years that blighted my life and that of my wife. I couldn't sit; I couldn't stand. I was on 500 mg of ibuprofen twice a day. Since that operation I really haven't played any sport at all.'

The ASR hip wasn't the only resurfacing option for Atkins in 2005, but he didn't know this. The John Charnley of hip resurfacing is a Birmingham-based surgeon called Derek McMinn. In 1997, after six years of trials, he put a hip resurfacing device, the Birmingham hip, on the market. Now made in Warwick by the British multinational Smith & Nephew, it has been used with relatively few problems around the world. The DePuy hip was designed explicitly to compete with the Birmingham hip – a device that did the job perfectly well. It could have been an improvement; it turned out to be anything but.

In 2005, the year Atkins was given the ASR hip, McMinn made a prescient attack on the rival product at a conference in Helsinki. He warned that the groove DePuy had cut around the edge of the metal hip socket meant greater pressure on the rim as patients moved around, making it more likely metal debris would shear

off and enter soft tissue. It might have been dismissed as the posturing of a rival, but disturbing reports were beginning to come in from Australia about problems with the hip.

The French authorities rejected the ASR in 2008, and though US regulators never approved it, the rules allowed American surgeons to implant it anyway. In Britain, the feeble agency that is supposed to monitor medical devices, the MHRA, didn't act. An investigation by the *British Medical Journal* pinpoints an early adopter of the ASR, Tony Nargol, a surgeon in North-East England, as one of the first to question its safety. He began getting bad feedback from patients in 2007. When he opened them up to investigate he was shocked to find that flesh and muscle around the hip had been destroyed; in some cases bone, too, was damaged.

Just as McMinn had warned, the ASR was shedding tiny fragments of cobalt-chromium, producing a devastating reaction in some patients. Further trouble was caused by individual atoms of cobalt and chromium leaching into patients' blood and spinal fluid. The evidence against the ASR began to escalate, but it was only in August 2010 that DePuy admitted defeat and issued a general recall of the hip. By that time the company had sold tens of thousands of the devices around the world. As lawyers began to gather clients for litigation, the scale of the disaster became apparent. Some of those who had signed up for the ASR in the hope of another 20 years of dancing or running or tennis may be permanently disabled. In March, British surgeons who had studied more data on the ASR suggested that a second version of the hip, designed for total hip replacement, would probably fail in half of cases after just six years. About 10,000 ASR hips were implanted in the UK. 'The really unlucky ones are those about 50 or 55 who had it done to extend their working careers,' Atkins said. 'There's no way they're going to work again.'

'I never made any secret of the fact that I had been one of the six surgeons contributing to the design of the ASR,' Cobb wrote to me in an email: 'Certainly most of my patients were aware of this. I can't remember exactly what was said to Mr Atkins before his first operation but I usually discussed the proposed use of the ASR, the advantages I perceived to be offered by it over the Birmingham device, and the further information available on the internet. I have no knowledge of a lifeboat coxswain featuring in any advertisements.'

The disturbing issues raised by the ASR hip fiasco – why was DePuy not obliged to test the device more rigorously by the authorities in Britain? Are other metal on metal hips a risk? – obscure a deeper question. Why are medical implants being marketed like iPhones, as in Smith & Nephew's video for the Birmingham hip at www.rediscoveryourgo.com, where to the accompaniment of a driving guitar track, strong, shadowy dudes with artificial hips ski, play football and climb rockfaces?

The progressive justification for the current changes to the NHS, expressed by people like the former Blair adviser Julian Le Grand, now on the board of trustees at the King's Fund, is that the only true recourse for patients who experience incompetence, rudeness, slovenliness, patronising behaviour and uncaringness by public servants is the power to send a message to the offenders by taking their custom elsewhere. Hence the ideal of 'choice'. But the weakness of the British authorities in the face of the ASR hip, and the ease with which DePuy salespeople persuaded British surgeons to use the ASR implant when tried and tested alternatives were available, doesn't make one confident that the people who run our health system have a clear idea of the difference between 'choice' and 'marketing'.

In 1993, an op-ed piece by three surgeons in the *BMJ* pointed out that a significant cause of long waiting lists for hip replacements was that hospitals blew their orthopaedic budgets on expensive new kinds of joint implant whose increased cost couldn't possibly be justified on medical grounds. Much of the cost of the latest medical devices, like the cost of a can of Coca-Cola, goes towards the marketing propaganda without which it would never occur to you to buy them. The article's parting barb – 'the implant industry remains a haven for all the excesses of free enterprise' – still applies. A recent report by Audit Scotland (where the NHS more closely resembles its pre-Enthoven form) noted that in Lothian, the average cost of a hip implant was £858. In neighbouring Forth Valley, NHS joint buyers were paying more than twice as much. In the US, a basic Charnley-style hip implant will now set you back $10,000, or £6100. Another type of hip has gone up in price

there by 242 per cent since 1991, when inflation has been only 60 per cent. The authors of *Transatlantic History* point out that some of the cheaper hips used in Britain aren't sold in the US, even though they're made there. Many surgeons and consumers want the best, they say, 'but when that which is properly known to be "the best" is ipso facto old technology, the best may come to mean "the latest", and the latest may be prove to be expensive failures.'

'There is no reason,' Aneurin Bevan wrote to doctors as the NHS came into being, 'why the whole of the doctor-patient relationship should not be freed from what most of us feel should be irrelevant to it, the money factor, the collection of fees or thinking how to pay fees – an aspect of practice already distasteful to many practitioners.'

I asked Martyn Porter how a place like Wrightington could survive in the marketplace if Porter the commercial manager failed to stop Porter the surgeon carrying out loss-making operations rivals wouldn't do. 'I came into medicine because if someone's injured, I want to fix them,' he said. 'Someone's going to fix them. Why not us? Secondly, you never get good, you get a little bit better. It's necessary at my age not to get bored. I'm just getting warmed up. However, the most important issue is the finance. We get a lot of money from the cheap and cheerful procedures, we take a hit on others. The managers are cool with that, as long as we're getting a reputation as a centre of orthopaedic excellence.'

The phone rang. The patient was ready. Porter wanted to talk some more about the Lansley project. 'I think there's a model there, but it's whether it can be delivered and won't be corrupted. I can see a very idealistic model, but by God, it's vulnerable to people ripping it off.'

Jill Charnley, now in her eighties, is the contented recipient of two artificial knees. They've lengthened her life, she says. Her shoulder gives her trouble and she could, if she wished, have a prosthesis put in for that, too, but she's made the choice not to. She's drawn the line, partly because of the physiotherapy involved and partly because she knows there's a limit to what medicine can achieve. 'We are all getting old,' she said, 'and bits of us wear out.'

There is only money in more, or in getting something. There is no money in less, or in getting nothing, even though less and nothing is everyone's eventual fate, and may be desirable long before that. The NHS can't avoid dealing with the financial consequences of its own success in enabling people to be old for longer and longer. But it can avoid becoming a victim of marketing.

In *The Charterhouse of Parma*, Stendhal wrote: 'The lover thinks more often of reaching his mistress than the husband of guarding his wife; the prisoner thinks more often of escaping than the jailer of shutting his door; and so, whatever the obstacles may be, the lover and the prisoner ought to succeed.' In the governance of Britain, it is as if the marketeers have internalised a modern version of this. The salesman thinks more often of making a sale than the consumer thinks he is being sold to; the lobbyist thinks more often of his loophole than the politician thinks of closing it; and so, whatever the obstacles may be, the salesman and the lobbyist are bound to succeed.

[*] Merlin, 128 pp., £12.95, April, 978 0 8503 6679 2.

[†] Palgrave, 256 pp., £55, 2007, 978 0 230 55314 9.

http://www.lrb.co.uk/v33/n18/james-meek/its-already-happened

Pay as you go solar power makes energy cheaper

- 17:45 30 September 2011 by **Jacob Aron**

Turn that sunshine into electricity (Image: Tanja Giessler/Getty)

Pay as you go is a common way of paying for calls on your cellphone. Now the idea could help make solar power a more realistic option for families in Kenya and other African countries.

The system, called IndiGo, consists of a low-cost flexible plastic 2.5W solar panel that charges a battery. This is connected to a USB mobile phone charger and an LED lamp that provides around 5 hours of light from one day's charge.

Developed by solar energy firm Eight19, based in Cambridge, UK, IndiGo costs $1 a week to run, though the unit itself must be leased for an initial $10 fee. Users add credit by buying a scratchcard that they validate by sending a text message from their phone.

IndiGo is being trialled in Kenya and will be tested in other countries in the next few months. Eight19 hopes the device will go on sale early next year. The company also plans to offer higher-power systems as demand for solar energy increases, such as a 50W system that could power a small TV.

No more kerosene

Many rural areas of countries such as Kenya are not connected to the electricity grid, so people light their homes using kerosene lamps. As well as being relatively expensive, these create smoke pollution and carbon emissions. Simon Bransfield-Garth, CEO of Eight19, says the high cost of fuel locks people into a cycle of poverty. "They're paying disproportionately large amounts for their energy," he says – typically $2 or £3 a week.

Bransfield-Garth says the benefits of his firm's solar power system aren't just economic - it will improve access to power too. People in rural Kenya currently pay around $0.20 to charge their phone, and many also have to travel to a charger. One man in the trial used to make a 2-hour round-trip each week and wait another 2 hours to actually charge his phone. He can now do it at home.

"There's no doubt it's a great development," says Sabah Abdullah , who researches sustainable energy development in developing countries at the University of Bath, UK. But she warns that the system could be hard for people with low literacy levels to use and that relying on a mobile phone for payment could marginalise those who can't afford such devices. "These are the people who really need a step up in terms of electrification."

http://www.newscientist.com/article/dn20991-pay-as-you-go-solar-power-makes-energy-cheaper.html?full=true&print=true

The reinvention of the night

Tim Blanning

Craig Koslofsky
EVENING'S EMPIRE
A history of the night in early modern Europe
433pp. Cambridge University Press. £55; paperback, £18.99 (US $90; paperback, $29.99).
978 0 521 89643 6

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Photograph: Bridgeman Art Library

I n 1710, Richard Steele wrote in Tatler that recently he had been to visit an old friend just come up to town from the country. But the latter had already gone to bed when Steele called at 8 pm. He returned at 11 o'clock the following morning, only to be told that his friend had just sat down to dinner. "In short", Steele commented, "I found that my old-fashioned friend religiously adhered to the example of his forefathers, and observed the same hours that had been kept in his family ever since the Conquest". During the previous generation or so, elites across Europe had moved their clocks forward by several hours. No longer a time reserved for sleep, the night time was now the right time for all manner of recreational and representational purposes. This is what Craig Koslofsky calls "nocturnalisation", defined as "the ongoing expansion of the legitimate social and symbolic uses of the night", a development to which he awards the status of "a revolution in early modern Europe".

The case is well made, supported by an impressive range of archival and printed sources, mostly French, English and German. More than fifty years ago, Richard Alewyn published his study of court festivities Das grosse Welttheater ("The great theatre of the world"). It proved to be highly influential, not only in its own right but also because it supplied Jürgen Habermas with much of what little empirical illustration he provided

in his even more seminal The Structural Transformation of the Public Sphere. Alewyn's main concern was the change that took place in the seventeenth century, as the grand secular festivals moved spatially from streets and public squares into palaces, and temporally from day to night. Now the carriages of courtiers going home to bed passed labourers going to work. Koslofsky gives due recognition to Alewyn's insight but goes a long way beyond it.

At the heart of his argument is the contrariety between day and night, light and dark. On the one hand, the sixteenth century witnessed an intensification of the association of the night with evil – "Night, thou foule mother of annoyaunce sad / Sister of heavie Death, and nourse of Woe", as Edmund Spenser put it. In part this derived from the excited religious atmosphere. While Hans Sachs hailed Martin Luther for waking humanity from the darkness of superstition, Thomas More repaid the nocturnal insult by identifying Lutherans with the dark night of heresy. Closely linked to confessional strife was the intensification of disputes over witchcraft. The witch-hunter's manual Malleus Maleficarum of 1486 had paid little attention to the night; a century later the night was well and truly diabolized. The Devil was now believed to be responsible for all "phantoms of the night", especially those resulting from sorcery, so witchcraft confessions typically focused on two nocturnal acts – the diabolic pact, often consummated sexually, and the Witches' Sabbath, also a riot of sexual licence. Peter Binsfeld, the suffragan Bishop of Trier, explained in 1589 that after his expulsion from Paradise, the Devil became dark and obscure and so performed all his foul deeds at night.

Christian disapproval of the night is as old as the New Testament. Unsurprisingly, St Paul's epistles equate darkness with evil, as does John's Gospel – "I am the light of the world: he that followeth me shall not walk in darkness". However, there was another albeit less obtrusive theological tradition advocating a path leading to God that was not brilliantly lit. Especially influential was Pseudo-Dionysius the Areopagite, the fifth-century Syrian thinker, who proclaimed: "I pray we could come to this darkness so far above light!". Those words are taken from his treatise The Mystical Theology and in the early modern period, too, it was the mystics who valued darkness. To the fore were two sixteenth-century saints – Teresa of Avila (1515–82) and John of the Cross (1542–91). In his poem "Dark Night", John praised his subject in language eerily anticipating the second act of Wagner's Tristan und Isolde: "Oh, night that guided me, Oh, night more lovely than the dawn, Oh, night that joined Beloved with lover, Lover transformed in the Beloved!".

The only light that John of the Cross trusted was the light that burned inside himself, in his heart. It was always those who preferred personal introspection to institutional dogma who found the dark side congenial. In his "Hymn to Christ" of 1619, John Donne wrote: "Churches are best for prayer, that have least light; / To see God only, I go out of sight: / And to 'scape stormy days, I choose / An everlasting night". Koslofsky draws on what seems to be an encyclopedic knowledge of the devotional literature of the period to demonstrate the popularity of this sort of belief. The benign image of the night also appealed to Protestants persecuted by Catholics and vice versa, for it was the time best suited for clandestine gatherings. And of course there was a biblical text at hand to lend support – John 3:1–3 – which tells of Nicodemus, who "came to Jesus by night".

Eventually the Catholic Church caught up, introducing new nocturnal practices, such as the devotion of the Forty Hours and lay processions during Holy Week. Immensely popular, they played a prominent role in the public piety of the seventeenth century. The former commemorated the forty hours between Christ's death and resurrection and necessarily lasted through at least one night. The public prayers and processions in darkness made "the site [of the devotion] more venerated through this clear dark obscurity", in the paradoxical words of one advocate.

It was the secular authorities, however, who made most use of ceremonial chiaroscuro. This is very much the domain of Alewyn, who wrote that the shift from street to court and from day to night represented "the sharpest break in the history of celebrations in the West", although Koslofsky has plenty to add on his own account. In the sixteenth century, he points out, the main media of royal representation were the jousts and tournaments held in the daytime, such as the Field of the Cloth of Gold, the Anglo-French spectacular of

1520. By the time of Louis XIV, all the major events – ballets de cour, operas, balls, masquerades, firework displays – took place at night (a major exception, of course, was hunting, about which Koslofsky has nothing to say). When was the "art of illumination" discovered in the Holy Roman Empire? asked a Saxon writer in 1736, and concluded that it must have been towards the end of the previous century.

The kings, courtiers – and those who sought to emulate them – adjusted their daily timetable accordingly. Unlike Steele's friend, they rose and went to bed later and later. Henry III of France, who was assassinated in 1589, usually had his last meal at 6 pm and was tucked up in bed by 8. Louis XIV's day began with a lever at 9 and ended (officially) at around midnight. The ladies of his court – and plenty of the men too – adapted their maquillage to take advantage of artificial lighting to draw attention to their rosy cheeks, white bosoms, jet black eyebrows and scarlet lips. As with so much else at Versailles, this was a development that served to distance the topmost elite from the rest of the population. Koslofsky speculates that it was driven by the need to find new sources of authority in a confessionally fragmented age.

We found it pleasant to be able to go, after midnight, to the far end of the Faubourg Saint-Germain

More directly – and convincingly – authoritarian was the campaign to "colonize" the night by reclaiming it from the previously dominant marginal groups. The most effective instrument was street-lighting, introduced to Paris in 1667, Lille also in 1667, Amsterdam in 1669, Hamburg in 1673, Turin in 1675, Berlin in 1682, Copenhagen in 1683, and London, where private companies were contracted to provide the service, between 1684 and 1694. This had little to do with technological progress, for until the nineteenth century only candles and oil lamps were available. Most advanced was the oil lamp developed in the 1660s by Jan van der Heyden, which used a current of air drawn into the protective glass-paned lantern to prevent the accretion of soot, and made Amsterdam the best-lit city in Europe. In one of the many well-chosen illustrations in the book, a nocturnal street scene from Leipzig in 1702 shows a row of van der Heyden lanterns allowing mixed couples to promenade, friends to recognize and greet each other, and even one solitary individual to read a newspaper.

At the end of the street is the reassuring sight of a nightwatchman, now able to see and protect the respectable citizens. They were the great beneficiaries of the great illumination; the victims were those to whom the streets had belonged when darkness ruled – students, the young in general, servants, vagrants, prostitutes and drinkers. All those, in other words, who had prompted Milton to write: "when night darkens the streets, then wander forth the sons of Belial, flown with insolence and wine". It was not a victory the authorities won easily (if indeed they ever did). The previous occupants responded with a Kristallnacht of lantern breaking, for which draconian penalties were inflicted – the galleys in France; amputation of a hand in Vienna (where twelve nightwatchmen were murdered between 1649 and 1720).

Yet gradually European towns and cities became safer places when the sun went down, and this security promoted forms of social activity beyond whoring, brawling, gambling and drinking. As Koslofsky very reasonably argues, almost all the work on the public sphere has concentrated on locations and institutional forms, and has neglected time. Coffee houses were open all day, of course, but it was at night that they came into their own. As the London pamphlet Character of Coffee and Coffee-House claimed in 1661, "they borrow of the night". Most served alcohol and many were frequented by prostitutes, but in general they served as respectable meeting places for the upper and middle classes. Moreover, as well as promoting a critical body of public opinion, they could also on occasion be the focus of more concerted political agitation. It was at the Turk's Head coffee house in New Palace Yard at Westminster that James Harrington's Rota Club met nightly in 1659–60 to discuss the future of the Commonwealth. Charles II tried to close coffee houses in 1675 for being "the great resort of Idle and disaffected persons", a verdict echoed by the patrician town council of Frankfurt am Main in 1703 when taking action against their own political opponents.

If educated urban men certainly benefited from this colonization of the night, it is much less clear how women fared. On the one hand, greater security encouraged them to go out at night. In 1673, Madame de Sévigné described an evening spent chatting with her friends until midnight at the home of Mme de Coulanges, after

which she escorted one of the party home, even though this involved a journey across Paris. She wrote that "We found it pleasant to be able to go, after midnight, to the far end of the Faubourg Saint-Germain", adding that the new street lighting had made this possible: "we returned merrily, thanks to the lanterns, safe from thieves". In John Vanbrugh's unfinished play A Journey to London (written in the early 1720s), Lord Loverule grumbles that his wife, Lady Arabella, was in the habit of staying out until the small hours despite knowing that he liked to retire at 11. She replies tartly that: "my two o'clock speaks life, activity, spirit, and vigour; your eleven has a dull, drowsy, stupid, good-for-nothing sound with it. It savours much of a mechanic, who must get to bed betimes that he may rise early to open his shop, faugh!". Her husband's further observation that early to bed and early to rise is healthy attracts the crushing rejoinder "beasts do it".

If these examples might seem to point towards emancipation, they refer only to aristocratic ladies with the means, the carriages and the self-confidence to roam about cities after dark. For the great majority, the new sites of nocturnal activity – the clubs, coffee houses, Masonic lodges and the like – were almost invariably "men only". Only in Paris, where coffee houses boasted a distinctly aristocratic decor, could women expect a welcome. Elsewhere in Europe, the exclusion of women prompts Koslofsky to endorse Joan Landes's verdict that "the bourgeois public is essentially, not just contingently, masculinist". It was the lot of women to be relegated to the "private core of the nuclear family's interior space", as Habermas has put it.

It was different in the countryside. Only where the witch-hunters had been especially busy was colonization achieved, and then only temporarily. It had always been the educated who had demonized folk beliefs, while the common people had made no automatic association between the night and evil or temptation. Particularly resistant, for example, in many parts of northern Europe was the "spinning bee", a nocturnal gathering of women to exchange gossip, stories, refreshment and – crucially – light and heat, as they spun wool or flax, knitted or sewed. It could also be a site of courtship, as young men could be admitted to add spice to these gatherings. Indeed, an illustration from Nuremberg depicts a regular orgy under way, including a priest "taking care of the cook". Repeated attempts to put a stop to spinning bees and other nocturnal activities got nowhere. As Koslofsky argues, the nocturnalization promoted by state power and a deepening public consumer culture was much less effective in the countryside, because what he also calls "a powerful combination of discipline and distinction" was much less in evidence than in the towns. The same could be said of the dark forces of the night. Street lighting had made life more difficult for criminals, but also for those who believed in ghosts, devils and things that go bump. Addressing an imaginary atheist in a sermon in 1629, John Donne invited him to look ahead just a few hours until midnight: "wake then; and then dark and alone, Hear God and ask thee then, remember that I asked thee now, Is there a God? and if thou darest, say No". A hundred years later, there were plenty of Europeans prepared to say "No". In 1729, the Paris police expressed grave anxiety about the spread of irreligion through late-night café discussions of the existence or non-existence of God.

Craig Koslofsky has given so much in this consistently stimulating, cogently argued and elegantly written book that it might seem churlish to ask for more. There are only a handful of brief references to the changing ways in which the night is treated by artists, and nothing at all about architecture. Crying out for attention are the chiaroscuro creations of – say – the Tomé family at Toledo or the Asam brothers at Weltenburg. Nor is there even a mention of Edward Young's hugely influential The Complaint, or, Night-Thoughts on Life, Death, and Immortality, first published in 1742, which heralded another seismic shift in the way in which the night was viewed. It is earnestly to be hoped that Koslofsky will address these and other aspects of this endlessly fascinating subject in a second instalment.

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http://www.the-tls.co.uk/tls/public/article780998.ece

How fast can he cook a chicken?

Mattathias Schwartz

- *Spills and Spin: The Inside Story of BP* by Tom Bergin
  Random House, 294 pp, £12.99, July 2011, ISBN 978 1 84794 081 0
- *A Hole at the Bottom of the Sea: The Race to Kill the BP Oil Gusher* by Joel Achenbach
  Simon and Schuster, 276 pp, $25.99, April 2011, ISBN 978 1 4516 2534 9

When crucial pieces of our infrastructure fail, they do so gracelessly, without much warning and in ways that are difficult to anticipate. The job of sifting through the wreckage falls to official investigators, who determine the event's 'root causes' and offer proposals for new safeguards. Their interventions restore our sense of security by placing what happened in a moral framework. The idea that accidents are caused by a few greedy or negligent individuals is more palatable than the alternative, that the guilty parties were doing exactly what was asked of them, blind to any consequences, like an engine that keeps pumping steam after its pipes break.

Extracting petroleum from the earth generates very high economic rewards – more than $2 trillion annually. There are also high costs, human and environmental, which resist measurement in purely economic terms. The combination tends to breed executives who seem to come from an alternate moral universe, one with unusually contingent notions of truth and responsibility. 'It's so much easier getting a project running in the developing world,' a British geologist who had been hired to prospect in China told me: 'If you lose a man, send a few thousand pounds back to his village and it's done with.'

Tom Bergin has spent more than a decade immersed in the oil and gas industry, first as an oil broker and later as Reuters' reporter on the sector. In April 2010, when the Deepwater Horizon blew out in the Gulf of Mexico, spilling almost five million barrels of oil and killing 11 men, he was there to observe the ensuing debacle, and how it played out at the highest levels of BP. The standard account of the spill attributes it to BP's ruthless cost-cutting and negligent attitude to safety. Bergin sticks to this line, though he also explains exactly how the company's managers came to institute negligence as corporate policy in the belief that they were serving the interests of shareholders. His attitude to BP's malfeasance is similar to that of the company's peers in the oil industry. By presenting the blowout as a low-probability event driven by BP's singular recklessness, he avoids questions about the safety of deepwater drilling in general and the likelihood of similar accidents occurring in the future. Most of his criticisms of BP's response to the spill are directed at Tony Hayward's public relations tactics. At some points he objects to the CEO managing perceptions with untruths; at others he offers advice on how he might have made his deceptions more effective. Overall, he is too much a creature of the industry to see the story of the Gulf spill as a warning about the way the industry sees the world.

Bergin's account starts in the 1980s with the rise of John Browne, the cosmopolitan striver-turned-mogul who was BP's chief executive from 1995 until 2007, when a young ex-boyfriend sold the story of their relationship to the *Mail on Sunday* and Browne resigned. (He has since headed the Browne Review of higher education, which called for the lifting of the cap on tuition fees last October.) The organisation he inherited was loaded with ballast left over from its early days as a monopoly. It looked more like a postcolonial bureaucracy than anything else; there were three tiers of lunch service at its Moorgate headquarters, and executives would greet the afternoon with sherry and martinis. Authority flowed according to a 'matrix structure', where each operating unit answered to two layers of supervisors: the executives responsible for their region and department heads in London.

The beginnings of the Deepwater Horizon disaster, Bergin argues, can be found in the reorganisation Browne undertook, applying to BP the leaner management principles he learned at Stanford. The company was divided into 'strategic business units', independent companies within the company, each of which could allocate its capital and manage projects as it saw fit. Managers were held to short-term 'performance contracts' focusing on high production and low cost. Those who could extract the most oil while spending the least money were rewarded with promotions and bonuses. Promising junior executives were shuffled between posts all over the world, rarely staying anywhere long enough to bother replacing outdated equipment or rusting pipelines. 'Go to the limit,' Browne told his managers. 'If we go too far, we can always pull back later.'

Bergin argues persuasively that such practices amounted to 'moral hazard', with BP not quite consciously rewarding the senior employees who engaged in the riskiest behaviour. The cost-cutting continued under Hayward, who trimmed BP of drillers, geologists and other specialists, outsourcing technical tasks to contractors and filling the company's top ranks with traders who knew how to allocate capital and whip subordinates into meeting the next quarter's targets. The demands for rapid production and low cost grew even more intense as Hayward instituted 'stretch targets' whereby the results achieved by one outperforming business unit were touted as company-wide goals.

Much the same sort of thing has been going on elsewhere, in manufacturing and retail in particular, since the late 1990s, when a new wave of Taylorism swept through management theory. Under the banner of euphemisms like 'accountability', workers' earnings and job security were linked to ever rising performance goals. For a retailer like Wal-Mart, there were few upper limits on efficiency targets – impossible goals could be passed down the chain of command until ambitious managers felt compelled to lock their minimum-wage employees in stores overnight. But oil and gas extraction were a special case. At the bottom of the production chain were the implacable realities of geology, whose limits could not safely be breached. 'Thus began a continuous effort to go beyond what BP's own engineers considered physically possible,' Bergin says of the stretch targets. One of the most important measurements was raw speed – how fast project leaders could get a hole drilled – calculated in 'days per 10,000 feet of drilling'. It was as though BP's senior executives in London had sent their workers into a room full of flammable gasoline vapours with a box of matches and a live chicken, offered prizes to whoever could produce a cooked chicken fastest, then handed the workers safety manuals, closed the door and turned their backs.

The Deepwater Horizon blew out on 20 April 2010, while drilling into a tract that BP had named Macondo. Transocean, the drilling contractor, was billing BP $500,000 a day for use of the rig, and the job was 45 days behind schedule. Bergin records the long series of cut corners and ignored warnings leading up to the event: a cheaper 'long string' piping system; a surge of gas in early March; a decision to use six piping centralisers (the number on board) instead of 21 (as recommended by the cementing contractor, Halliburton); a design that left only a single cement barrier separating the wellhead from the rig thousands of feet above. Worst of all was the way the cementing was done as the Deepwater Horizon prepared to seal off the completed well. BP personnel ignored an email from Halliburton warning of flaws in the cementing plan, and then misread the results of a pressure test indicating a massive build-up of pressure inside the well. The last warning, a dangerously high reading on a pressure gauge, went unnoticed by the head driller for 40 minutes. Then black drilling mud began spilling out onto the drilling floor, and it was too late.

The *Washington Post* reporter Joel Achenbach provides a more thorough account of the engineering decisions in the hours before the blowout. Where Bergin draws most of his details on the blowout from the top layer of data – widely publicised hearings and commission reports – Achenbach examines the many public hearings held by the Marine Board of Investigation in New Orleans to ascertain what actually took place on the rig. Among his findings is testimony about a discussion held in the Deepwater Horizon's drilling room to determine why there were 1400 pounds of pressure in the drill pipe if the cement job had worked and the well was indeed sealed. Just before the blowout several workers on the rig persuaded one another that the pressure was caused by a 'bladder effect', when the glaring but inconvenient truth was that the cement job had failed.

Three of the men in the drill shack, including the one said to have suggested the bladder effect, would be killed less than 24 hours later in the blowout. Their willingness to explain away the anomalous pressure readings should be remembered alongside Stanley Milgram's famous electroshock experiments as a case study of the extent to which authority can warp perception.

After the blowout BP behaved like a well-trained Mafioso. At first it denied everything and attempted to pass primary responsibility for the disaster onto Transocean. Then it grudgingly admitted what could not be denied. Finally, when the Federal Reserve had begun to consider the possibility that the company be declared bankrupt, BP tried to bribe the jury, offering billions of dollars to the US public in the hope that it would turn back the tide of mass opinion and be permitted to continue operating in the Gulf of Mexico. Bergin recalls little-known facts from Hayward's early career to illustrate his casual relationship with the truth. Working under Browne, he exaggerated the size of prospects in Colombia and Venezuela in order to shore up the confidence of investors. But he had no experience of crisis management on the scale demanded by the Gulf spill. BP spent months at the top of a 24-hour news cycle; the smallest untruths were quickly exposed and made much of as the latest developments in an unfolding scandal. Like most oil men, Hayward seemed to feel entitled to the world's gratitude. 'Because I am blessed by my good brain,' Robert Horton, one of Browne's predecessors, boasted, 'I tend to get the right answer rather quicker and more often than most people.' It's not difficult to imagine Hayward saying something similar. He committed gaffe after gaffe – denying responsibility, grossly underestimating the volume of the spill, raising expectations for a vain attempt to plug the hole with drilling mud known as 'top kill', and wishing to have 'my life back'.

During the crisis it appears that BP saw Bergin as a sympathetic conduit for getting the company's message out, and even now he expresses chagrin at the abuse the US media heaped on BP's managers, whom he calls 'essentially decent people'. Initially, BP estimated that Macondo was releasing a thousand barrels each day, then raised the estimate to 5000. The second figure proved to be about one tenth of the actual flow rate and was dismissed in the US media as another of Hayward's self-serving lies. Bergin, however, reports that BP's engineers built the 5000-barrel estimate into their models when attempting to cap the spill. In his analysis, this mistake prolonged the spill by as much as a month, an indication of how unprepared BP was to deal with an accident of this magnitude. The company went into a sort of institutional shock, confusing the lies it was telling the public with its own analysis of the accident.

Public reaction in the US went through several phases. First was the spill's gradual rise to the top of the headlines, as its scale and apparent intractability became clear. According to the logic that drives American news stories, every tragedy has to have a villain, preferably a foreign villain, and public anger settled on Hayward. For a few weeks it looked as though the drive for vengeance might spread to the whole enterprise of deepwater drilling in the Gulf, until politicians in the state of Louisiana redirected the hostility onto Obama and the supposed inadequacy of the federal government's response. Billy Nungesser, the local official who led the campaign to blame the president and predicted that the spill would be 'Obama's Katrina', doesn't appear in Bergin's book. Two brief mentions are made of Louisiana's governor, Bobby Jindal, the charismatic Republican born to Indian immigrants who legitimised Nungesser's anti-federal rhetoric. In Louisiana, where oil gives the people jobs and the government royalties, it was easy to shift the spill narrative away from petroleum v. fish to a more Katrina-like federal v. local script. The oil industry, as Bergin notes, relies on the goodwill of populations whose resources it exploits, a dependency that has made for such strange bedfellows as the Shah of Iran, among many others. Even stranger was the sight of Jindal and Nungesser, two down-home reactionaries, arguing for the interests of multinational corporate elites in the guise of nativist protectionism. This trick was made possible by Obama's short-lived moratorium on deepwater drilling, which they presented as an insult on a par with the spill itself.

Jindal and Nungesser deserve much of the credit for the fact that the spill, which Obama seemed to be testing as a pivot for the future of oil, didn't bring about any lasting change in US energy policy. The Mineral Management Service, the agency responsible for overseeing Deepwater Horizon's drilling plans, was renamed the Bureau of Ocean Energy Management, Regulation and Enforcement, but the conflict between its

interests as royalty collector and regulator remains. The moratorium has ended. Obama's administration appears to be backing the proposed $7 billion extension of the Keystone Pipeline System, which would carry Canadian tar sands oil more than 2100 miles to Texas. The next auction of blocks of deepwater Gulf leases is scheduled for December in New Orleans. BP is expected to be among the bidders.

One reason for the oil and gas industry's quick comeback in the US was the successful packaging of the blowout as a 'black swan', an event of such low probability that it couldn't have been anticipated. This certainly helped excuse the fact that no one – not BP, Chevron, Exxon or Shell – had a working plan for plugging a blowout as deep as Macondo, which was why BP's engineers had to design their countermeasures on the hoof. Bergin, too, attempts to quarantine the problem, arguing that the spill would never have happened had BP's management correctly assessed the long-term interests of profit-seeking shareholders.

More troubling still is the sense one gets not only that no one on the Deepwater Horizon understood the operation of the rig as a whole, but that even after so many hours of scrutiny on the part of both journalists and the government, no one outside the oil industry really understands how a deepwater rig works. The failure to grasp the possibility of system-wide failure might be one in an accelerating series, bookended by the 2008 financial crisis and the Fukushima nuclear meltdown last spring.

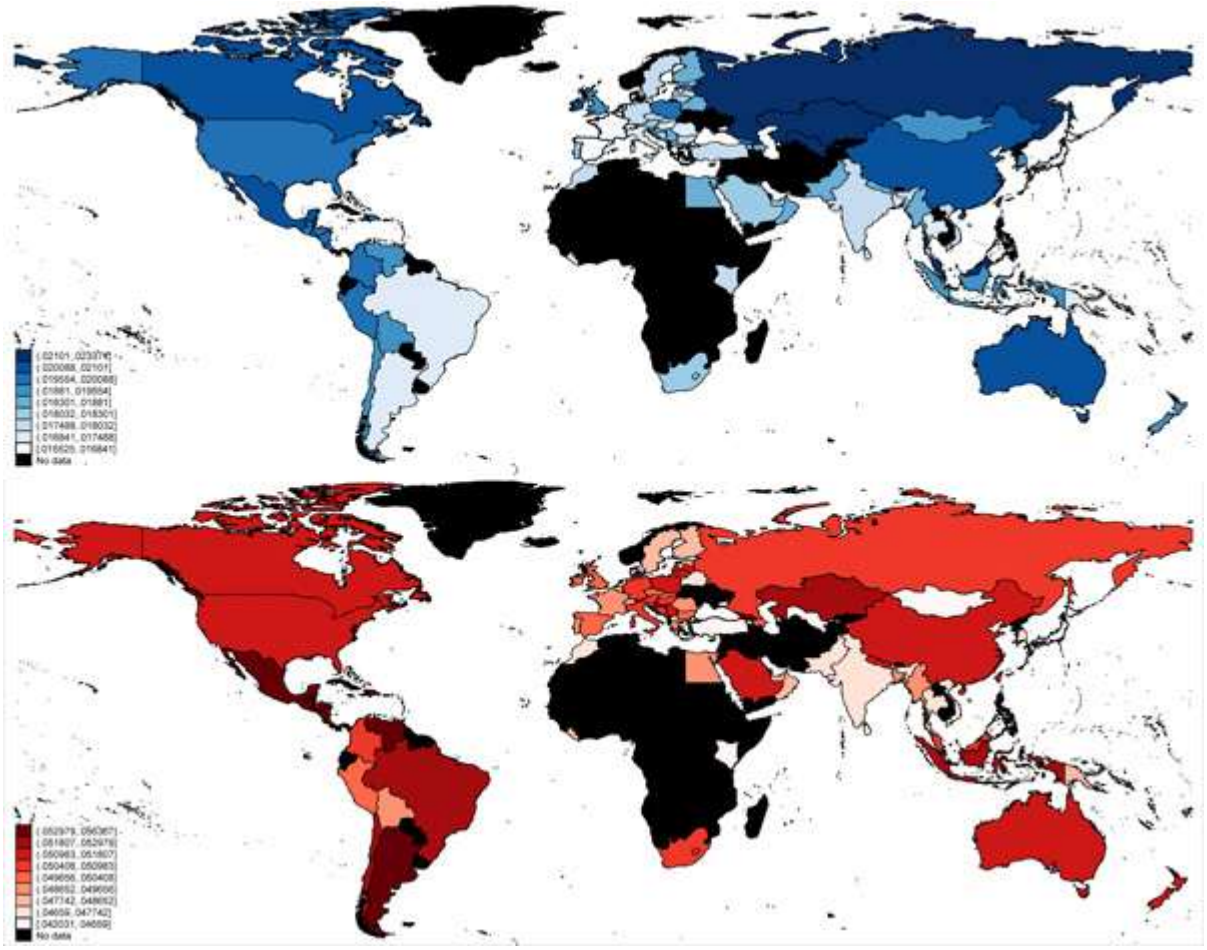
'It seems likely,' Achenbach writes, 'that the truth about Macondo will always be clouded by uncertainties, errors, misinformation … much of this is being litigated, ferociously, and that makes it harder to find a consensus on what really happened.' The oil industry's authority, like that of the banks, comes from the laity's dependence on the systems the industries themselves have built and mastered. Even when that mastery breaks down, as it did with the banks, consumers have little choice but to allow the guilty parties back in the control room. Catastrophes give the lie to the illusion that it is a fiduciary relationship. BP was counting on this lack of public understanding when it claimed, in its own report on the blowout, that the event had eight causes, of which BP was partly responsible for one. The president's commission concluded that the disaster had nine causes, and that BP was responsible for six or seven. And yet BP stands by what it said at the start. The size of the system and the complexity of the data make it possible to argue for a maddeningly wide range of positions, especially when it comes to vague legal notions like 'negligence' or 'responsibility'. Both concepts hinge on proving that one linear narrative is the right one. As the environmental consequences of the spill play out over years, if not decades, BP will probably cobble together data to make it seem that the effects have been negligible. The campaign will resemble the oil and gas industry's decade-long finessing of the climate change question, but it will be easier. By the time the experts are able to make a full assessment of the spill's effects, assisted by BP's $500 million fund for 'independent research', the books will long since have been written.

http://www.lrb.co.uk/v33/n19/mattathias-schwartz/how-fast-can-he-cook-a-chicken

Twitter mood map reveals the world's emotions

00:05 30 September 2011

Jacob Aron, technology reporter



Mapping the mood: average negative (blue map, top) and positive (red map, bottom) feelings for each country *(Image: Science/AAAS)*

Twitter users who post messages such as "Yay, it's the weekend!" might not be engaged in the most stimulating of conversations. But these kinds of tweets can provide sociologists with a map of people's moods around the world.

Scott Golder and Michael Macy at Cornell University in New York gathered 509 million tweets from 2.4 million users in 84 different countries. They and analysed the messages using linguistic software that looks for positive or negative emotions within the text. They found that people tend to wake up in a good mood, which deteriorates as the day wears on. People tend to also be happier at the weekend, when the morning

good-mood peak tends to be delayed by two hours, suggesting a lie-in. People are less positive during the winter, when the hours of daylight are shorter.

None of these results are particularly surprising, but Golder and Macy suggest that using global tweets allows them to confirm previous studies that only looked at small samples of American undergraduates who were not necessarily representative of the wider world. Traditional studies also require participants to recall their past emotions, whereas tweets can be gathered in real time.

The Twitter approach has also been tried before, but this is the first time researchers have gathered data on a global scale. While people's moods seem to be consistent across countries and cultures, Golder and Macy did identify a shift in weekend moods in the United Arab Emirates, where the work week runs from Sunday to Thursday. Their results were published today in the journal *Science*.

http://www.newscientist.com/blogs/onepercent/2011/09/twitter-reveals-the-worlds-emo-1.html

Arctic ozone hole breaks all records

- 18:00 02 October 2011 by **Michael Marshall**

In the first three months of this year, something unprecedented happened in the skies over the Arctic. A large hole appeared in the ozone layer, far bigger than any seen there before.The Arctic ozone layer suffers a little damage every winter, but the effect is normally short-lived. "This is a clear step beyond that," says Neil Harris of the University of Cambridge. As the measurements came in, ozone researchers began to debate whether the loss could be compared to that seen over the Antarctic. "It's the first time we've even discussed that question," says Harris.

Between 18 and 20 kilometres up, over 80 per cent of the existing ozone was destroyed. "The loss in 2011 was twice that in the two previous record-setting Arctic winters, 1996 and 2005," says Nathaniel Livesey of the Jet Propulsion Laboratory in Pasadena, California.

The hole was similar in size to those seen in Antarctica in the 1980s. The Antarctic hole has continued to grow since then, and is far larger today.

The Arctic ozone hole will have allowed more ultraviolet radiation than before through, but it is unlikely anyone has been seriously harmed, says Bruce Anderson of the University of Sydney, Australia. "Occasional ozone depletion episodes such as this would add very little to the underlying population's risk of UV-related cancer."

Ozone killer

The question now vexing atmospheric scientists is why the hole grew so large, and whether it will open again. Livesey and his colleague Michelle Santee say the hole formed because the stratosphere remained cold for several months longer than usual. The cold air allowed water vapour and nitric acid to condense into polar stratospheric clouds, which catalyse the conversion of chlorine into chemically active forms that destroy ozone.But we don't know why the stratosphere stayed cold for so long. "That will be studied for years to come," Santee says.

Chilly skies

Climate change could be partly responsible. That may seem counter-intuitive, but global warming occurs only at the bottom of the atmosphere. "Climate change warms the surface but cools the stratosphere," Harris explains.

In 2007 the Intergovernmental Panel on Climate Change concluded that "there has been global stratospheric cooling since 1979". "Whether that is because of climate change is speculation," Santee says.

More work must be done to find out if climate change is leading to stratospheric cooling – and encouraging the formation of ozone holes over the Arctic. Climate modellers are paying closer attention to the stratosphere than they did just a few years ago: it turns out to be crucial for many phenomena, including the subtle effects of the sun on regional climate.

Journal reference: *Nature*, DOI: 10.1038/nature10556

http://www.newscientist.com/article/dn20988-arctic-ozone-hole-breaks-all-records.html?full=true&print=true

Pissing on Idiots

Colin Burrow

- Buy*Richard Bentley: Poetry and Enlightenment* by Kristine Louise Haugen
  Harvard, 333 pp, £29.95, April 2011, ISBN 978 0 674 05871 2

Many years ago, when there were still second-hand bookshops in which to skulk, I found a leather-bound volume with 'BENTLEY'S HORACE' on its spine. It was only twenty quid, so I dropped into the standard routine for bagging a bargain. You'd toy with a few other things, then take the one you really wanted to the desk with some gesture that said, 'Oh well, I might as well pick up this old thing too.' I hoped the volume was going to be Richard Bentley's 1711 edition of Horace, which is full of his sometimes inspired and sometimes not so inspired conjectural emendations. When I got it home I found it was an English translation of Bentley's notes on Horace's *Odes*, along with 'Notes upon Notes Done in the Bentleian Stile and Manner', which the hack publisher Bernard Lintott produced in 1712 to cash in on the fame of Bentley's Horace.

Bentley's notes were translated in a way that deliberately exaggerated the crabby vigour and indecorum of his style: 'Since then I was satisfy'd, that Horace did not write this, but that it was foisted in by the Crew of Librarians, I began to cast about.' The 'Notes upon Notes' were intended to draw attention to Bentley's extreme arrogance, so when he defended a reading in Horace's *Odes*, the anonymous 'Bentleian' annotator added this gloss:

The Dr. having called together an Assembly of Criticks, by the Names and Titles of *most Learned*, *most Accurate*, *most Ingenious*, *most Judicious*, *most Illustrious,* and so forth, tells them when they are met, that they are a company of *Blunderers* and *Blockheads*, and that there is a Commentator in the World, one Dr. *B*, more *Learned, Accurate, Ingenious, Judicious* and *Illustrious* than all of them put together.

This representation of Bentley as a figure of overweening arrogance was one which I, like most students of English literature, was primed to accept. In *The Dunciad in Four Books* (1742), Pope described Bentley as the 'mighty Scholiast, whose unweary'd pains/ Made Horace dull, and humbled Milton's strains.' Pope added notes to *The Dunciad*, and indeed notes upon notes, in the Bentleian manner. The gem is the note to the lines 'a Sage appears,/By his broad shoulders known, and length of ears.' The annotator solemnly cites a string of critics who have unthinkingly accepted the received reading of the text, which he claims 'proceeded originally from the inadvertency of some Transcriber', and concludes: 'A very little Sagacity (which all these Gentlemen therefore wanted) will restore to us the true sense of the Poet, thus, *By his broad shoulders known, and length of* years.' The Bentleian textual critic-annotator revels in his own false modesty. His restoration of the 'true' reading proves beyond all doubt that he could not recognise an ass by the length of its ears.

Bentley was, however, no ass. Despite his Yorkshire accent, his Whiggish politics and his grammar-school background, he became master of Trinity College, Cambridge in 1700, when he was only 38. He did many good works. He provided an observatory and a laboratory for the college, and helped create the Backs by draining and replanting fenny pastures. But as an academic politician he was a disaster. He attempted to annex the fellows' bowling green to the master's garden. Then he made his colleagues donate their dividend towards repairing the chapel. He also tried to readjust the annual distribution of the college's income so that he received not just the lion's but the leviathan's share. He ejected two fellows from their posts. To quash opposition he had a go at closing down the combination room in which the plots against him were hatched. The fellows took their master first to the college visitor (the Bishop of Ely, who was supposed to arbitrate in these kinds of dispute) and then repeatedly to court. His more colourful biographers dwell on other scandals too: when a gun was discharged into the study of the master of Caius (next door to Trinity) it was surely

unthinkable that the master of Trinity could have pulled the trigger. Or was it? Thomas Gooch, the Tory master of Caius, had in his capacity as vice-chancellor tried to strip Bentley of his degrees.

Among all this brouhaha Bentley managed to establish a reputation as the most learned classical scholar in England. Early in his career, after a stint as tutor to the son of the preacher and scholar Edward Stillingfleet, he intervened in the so-called Battle of the Books. This was, roughly speaking, an argument between the 'ancients', who claimed that 'the oldest Books we have are still in their kind the best', and the 'moderns', who thought that literature and learning might have improved since antiquity. Bentley's part in this scholarly war was a drily destructive *Dissertation upon the Epistles of Phalaris* (1697). This attacked Swift's patron Sir William Temple, who had unwisely claimed that a set of letters purporting to be by the Sicilian tyrant Phalaris (who lived in the sixth century BC) were among the earliest surviving Greek texts. Bentley grinds through the epistles, showing that the customs they record and much of their vocabulary must date from centuries after Phalaris. He began to hone his own distinctive style, that of an infinitely learned man whose spirit was entirely untainted by generosity: 'A strange piece of stupidity, or else contempt of his Readers,' he growled, 'to pretend to assume the garb and person of Phalaris, and yet knowingly to put words in his mouth, not heard of till a whole Century after him.'

Kristine Haugen's Bentley is a different beast. He is not the tyrant of Trinity, or the dunce of all dunces, but the man who connected English classical scholarship to the European republic of letters. She regards him as the heir of Joseph Scaliger, himself a master of vast learning and of a prose style that could bring water to the eyes of his adversaries. Her early chapters show how much Bentley owed to the classical editors who preceded him in Cambridge, Thomas Stanley and Thomas Gale. Otherwise, she tends to treat the English dimensions of Bentley's career as a sideshow. Her main objective is to explain how Bentley could be simultaneously one of the greatest classical scholars of his age and the object of so much mockery. His problem, she argues, was that he was among the first to present to a wider public the methods of philologically informed textual criticism. He 'aimed at a totally new kind of convergence between scholarship and polite literary culture, akin to that in Renaissance Italy or 17th-century France'. But polite English readers could not understand why he cited Suidas (a Byzantine encyclopedist) so often, or why he focused such critical vigour on a single letter in a received text, let alone why he devoted so much time to texts of little literary merit, such as the *Astronomica* of Manilius. Pope, she argues, responded jealously to Bentley's new method of close textual attention: his 'attacks on Bentley … were in large part defensive manoeuvres designed to neutralise Bentley, and claim the critical laurel for Pope himself'.

Not the least of Haugen's many virtues is her ability to describe extremely technical debates clearly. It is hard to imagine better descriptions of Bentley's role in the recovery of the digamma (the archaic Greek character which can sometimes be used to make sense of Homer's metre), of his attitudes towards the Johannine comma (the principal biblical source text for the doctrine of the Trinity, long suspected to be a forgery), or the highly contentious question of the metre of Terence. Bentley emerges as the grandfather of all driven dons: he built up a circle of disciples, revamped the Cambridge University Press and sought ever more ambitious 'projects' to sell to his patrons and to the public, which would confirm him as a 'public intellectual'. His real significance, she claims, was to have stirred English literary criticism out of the doldrums of stodgy Aristotelianism, and to have encouraged 'close reading, the signature method of English study in the 20th century'.

Haugen's argument, like many correctives to orthodoxy, may go a little far. The price of embedding Bentley in European traditions of classical scholarship is to downgrade his complex role in English literary culture. Many English responses to Bentley undoubtedly arose from hostility to his ungentlemanly background and to his politics, but they were also a result of genuine problems in Bentley's rhetoric and his methods of emendation. Many of these problems came to a head in 1732, with the publication of his edition of *Paradise Lost*. Bentley claimed that an amanuensis had introduced many errors, absurdities and interpolations into Milton's poem, which, in the absence of any manuscript versions, could be cleansed of them only by the 'Sagacity, and happy Conjecture' of the critic. Presented with a text 'polluted with such monstrous Faults, as

are beyond Example in any other printed Book', he aimed to bring about 'a Restoration of the Genuine *Milton*'. Haugen argues that Bentley's treatment of Milton was the direct offshoot of his great edition of the *Astronomica*, whose text Scaliger had argued was shot through with later interpolations. This may not be the whole story, since there is good evidence that Bentley had been thinking about emending Milton for decades. Nonetheless, the edition of *Paradise Lost* was the real test of Bentley's literary ear. His emendations to its final lines give a taste of how radically he corrupted Milton in order to relieve him of corruption. The tentative paradoxes of Milton's ending ('They hand in hand with wand'ring steps and slow,/ Through Eden took their solitary way') become 'Then hand in hand with Social steps their way/ Through Eden took, With Heav'nly Comfort cheer'd.' The edition had, as they say, mixed reviews.

This was largely because Bentley's treatment of *Paradise Lost* exposed in acute form and in the vernacular the problems intrinsic to conjectural emendation. His method was founded on two techniques which were on a collision course. Much of the time Bentley assumes that a poet's language is special and that flat or dull phrases are the result of scribes making it conform to normal usage. The conjectural editor therefore can act as a kind of inspired genius, who by changing a letter, or two or three, reveals the true reading that a scribe has dulled. As Bentley said of one of his conjectural emendations to Manilius: 'If you are just, you will attribute it to the author himself, not to me.' At other times, though, the conjectural editor works in more or less the opposite direction. If a reading looks odd, Bentley uses his knowledge of the grammatical, stylistic and metrical conventions of the text to 'restore' a reading that the norms of speech would require. This means he will prefer the obvious phrase 'length of years' to the deliberately unusual 'length of ears', and will take the abnormality of the latter as a mark of corruption rather than poetic skill. This is why Pope made Bentley say in *The Dunciad* 'Turn what they will to Verse, their toil is vain,/Critics like me shall make it prose again'.

And this is also why Bentley's Milton was the graveyard of his method. As both Christopher Ricks and William Empson recognised, Bentley had a remarkable ability to spot the poetically dazzling in Milton. The trouble was he would then emend it away. When Milton's devils smelt gold from ore, Milton says they 'scumm'd the bullion dross'. Most readers would realise that Milton is producing a paradox which suggests that gold is no more than dross. Bentley adds a note to this line, a note so much in the Bentleian manner that it sounds like self-parody: 'A strange Blunder to pass through all the Editions. Who ever heard of *Bullion Dross*? *Bullion* is the purified Ore, *Dross* is the Scum and Refuse of it. The Author gave it, *Severing each kind, and scum'd* FROM *Bullion Dross*.' In editing *Paradise Lost* Bentley revealed himself not as a simple dunce, but as a brilliant dunce.

Even if he did not have the ear of a close reader, he certainly did make and mark major changes to the tenor of English classical scholarship. Editions of classical texts by English scholars in the earlier 17th century were generally poor affairs, by continental standards. Thomas Farnaby, who edited Seneca's plays, and John Bond, the editor of Horace, were both schoolmasters and aimed to produce editions which explained what poets meant in terms that could be understood by grammar school and university students. The generation of scholars around Bentley brought about huge advances in the ways classical texts were edited and emended, and set classical scholarship on the trail that would lead to Karl Lachmann's work on manuscript traditions in the early 19th century. But there was a price. It brought into the heart of classical study a focus on textual detail that is the direct ancestor not of the New Criticism, as Haugen suggests, but of A.E. Housman and a body of classicists who regarded the discovery and emendation of mangled texts – ideally texts that existed only in fragments – as the highest task of scholarship. For these men literary criticism was for the vulgar or the dim. As William King put it in his *Dialogues of the Dead* (1699): 'It is not a Criticks business to read Marbles, but out of *Broken pieces* to guess at 'em, and then positively to restore 'em.'

The treatment of classical texts as fragments to be restored and explained was one of the primary impulses behind the earliest humanistic discoveries of works from the classical past. But Bentley's generation made it an end in itself, and they combined it with a new editorial style. He and his followers were determined to show that they were scholars rather than schoolmasters or moralists. As a result they tended to separate their critical method from all the reasons earlier humanists such as Erasmus might have given for reading classical

poetry – a desire to develop a style of expression which was tied to moral excellence, a wish to imitate the works of a classical author, even a love of beauty. They also disguised the patient and often very dull labour of the scholar beneath a savage rhetorical style. That unhealthy bond between the driest kinds of learning and the sharpest kinds of style may (who knows?) persist in some of the darker corners of the academy today. Certainly when Housman praised Bentley's edition of Manilius he indulged to the full his own version of the Bentleian style:

If a man will comprehend the richness and variety of the universe, and inspire his mind with a due measure of wonder and awe, he must contemplate the human intellect not only on its heights of genius but in its abysses of ineptitude; and it might be fruitlessly debated to the end of time whether Richard Bentley or Elias Stoeber was the more marvellous work of the creator: Elias Stoeber, whose reprint of Bentley's text, with a commentary intended to confute it, saw the light in 1767 at Strasbourg, a city still famous for its geese … Stoeber's mind, though that is no name to call it by, was one which turned as unswervingly to the false, the meaningless, the unmetrical and the ungrammatical, as the needle to the pole.

Gibbon and Johnson underlie the shape of Housman's sentences, and give his prose a civilised cruelty Bentley never quite mastered. But the spirit of Bentley is also there. The scholar's mind encompasses the full majesty of the universe, its heights, its depths. It does not shrink from detail, deigning even to know that Strasbourg is famous for foie gras. The scholar uses that infinite knowledge to achieve the two great ends of scholarship: to emend classical texts and to piss on idiots. Bentley probably does not lie beneath the foundations of 20th-century literary criticism, but he did help to create the least humane offshoot of humanistic study: the voice of the scholarly editor.

http://www.lrb.co.uk/v33/n19/colin-burrow/pissing-on-idiots

Fukushima's radioactive sea contamination lingers

- 16:14 30 September 2011 by **Andy Coghlan**

Police and other workers practise a search on the Fukushima coast earlier this month. Exhaust towers of the Fukushima No. 1 nuclear power plant are visible in the background *(Image: Masamine Kawaguchi/The Yomiuri Shimbun/AP/PA)*

Levels of radiation in the sea off the Fukushima-Daiichi nuclear plant remain stubbornly high six months after the earthquake and tsunami struck Japan on 11 March.

After levels peaked at around 100,000 becquerels per cubic metre of seawater in early April, much of the radioactive iodine, caesium and plutonium from Fukushima was expected to rapidly disperse in the Pacific Ocean.

Instead, it seems that the levels remain high. That could be because contaminated water is still leaking into the sea from the nuclear plant, because currents are trapping the material that's already there, or both.

Ken Buesseler of Woods Hole Oceanographic Institution, Massachusetts, has told *The New York Times* that he has received samples of seawater taken in July from near the plant that contained 10,000 becquerels per cubic metre. The corresponding level last year, only months before the disaster, was just 1.5 becquerels, he says.

Simon Boxall, an oceanographer at the University of Southampton, UK, says that much of the radioactive material will still be sinking down to the seabed and being absorbed by marine life.

Current trap

Boxall says that a strong ocean current called the kuroshio – the Japanese equivalent of the Atlantic Gulf Stream – may be responsible for the persistence of the radiation.

The kuroshio skirts the Japanese seaboard, sweeping material into the deep ocean. But closer to shore, it creates huge eddies 80 to 100 kilometres across, which may send the material back towards the shore instead of dispersing it.

In June, Buesseler took his own samples off the coast of Japan. He wants to have his findings analysed before publishing them, but at present they suggest Boxall may be right: further out to sea, from 30 to 600 kilometres offshore, the radiation threat drops off.

It's not surprising that sea life hasn't yet swept up the radioactive material, says Boxall. Seaweed tends to accumulate radioactive iodine-131, which rapidly decays, he says – but caesium-134 and caesium 137, with half-lives of two and 30 years respectively, accumulate in shellfish and could persist for decades. "There's no reason to think it would drop so soon after the disaster," he says.

Peak leaks

Official estimates from the Japanese government and TEPCO, the company that owns Fukushima-Daiichi, suggest that 3500 terabecquerels of caesium-137 from the plant entered the ocean between 11 March and late May. The pollution was exacerbated in April by problems locating a persistent leak of contaminated water and a decision by TEPCO to dump contaminated water at sea. A further 10,000 terabecquerels of caesium-137 is thought to have found its way into the ocean after escaping as steam from the facility. And TEPCO said last week that Fukushima-Daiichi may still be leaking as much as 500 tonnes of contaminated water into the sea every day.

"It wouldn't surprise me if there is still caesium entering the sea off Fukushima, but it can't be as bad as in March and April," says Richard Wakeford of the University of Manchester, UK.

"The important thing is to keep monitoring to understand what's happening, and particularly to keep an eye on levels in seafood," he says. "The reports I've seen suggest that there isn't an immediate problem with seafood contamination, but it is important to maintain a comprehensive monitoring programme."

Dirty soil

There have also been significant developments this week in Japan's plans to cope with land and soil contaminated by airborne pollution from the reactors, mainly released in explosions and fires in March and April.

On Tuesday, the Japanese environment ministry said that about 30 million cubic metres of contaminated soil and vegetation from around Fukushima prefecture may need to be disposed of – 23 times the volume of the iconic Tokyo Dome baseball stadium in the capital. The volume is so high because an expert panel recommended that 5 centimetres of topsoil should be shaved off contaminated areas, mainly farmland, but also including forested and residential areas.

A day later, the ministry unveiled a plan to build temporary storage facilities for the soil in eight prefectures in different parts of Japan.

Meanwhile there was good news this week from Fukushima-Daiichi itself. TEPCO reported on Wednesday that for the first time since the disaster on 11 March, the temperatures of all three of the most severely damaged reactor units had fallen below 100 °C – a key step towards the goal of cold shutdown, which will effectively mothball the reactors for good.

The final reactor to fall below 100 °C was unit 2, the source of much of the leaked water in April.

http://www.newscientist.com/article/dn20990-fukushimas-radioactive-sea-contamination-lingers.html

Air pollution is stunting India's monsoon

- 12:16 30 September 2011 by **Michael Marshall**
- For similar stories, visit the **Climate Change** Topic Guide

India has been drying out for half a century, and air pollution thousands of kilometres away is partly to blame.

The monsoon has been weakening since the 1950s. Indian air pollution has been blamed, but now it seems that emissions further afield are also a factor.

"The summer monsoon provides up to 80 per cent of total annual rainfall in south Asia, and supports 20 per cent of the world's population," says Yi Ming of Princeton University in New Jersey. With his colleagues, Ming used climate models to assess how different factors changed the monsoon.

The monsoon is brought by large-scale wind patterns that transport heat between the northern and southern hemispheres. For half the year the northern hemisphere experiences more solar heating and so is warmer than the southern hemisphere; the situation is reversed during the other six months. As the winds head north over the Indian Ocean during the northern hemisphere's summer they pick up moisture, which falls as rain over south Asia.

Air pollution in the form of aerosols can weaken these long-distance wind patterns, however. That's because it reflects sunlight back into space, cooling the polluted area. Thick aerosol pollution over Europe in summer ensures that the northern hemisphere isn't much warmer than the southern hemisphere, so there is nothing to drive the winds – and nothing to trigger the monsoon.

Lurching rains

Ming says his modelling suggests that the effect of European aerosol pollution accounts for about half the drop in the volume of monsoon rainfall – the other half is down to pollution over south Asia. In as-yet-unpublished experiments, he confirmed the important role that the European pollution plays in weakening the monsoon. He ran his models again, this time assuming no aerosol pollution over south Asia. Even so, India had a significantly weaker monsoon.

The study supports existing evidence that air pollution is weakening the monsoon, says Veerabhadran Ramanathan of the University of California, San Diego.

Another form of pollution – greenhouse gas emissions – is pushing the monsoon in the other direction, towards greater rainfall, says Ramanathan. The competing forces of the greenhouse effect and air pollution may lead to a much more variable monsoon, with drought one year followed by floods the next. He says this erratic behaviour is "more worrisome" than the overall decrease in rainfall.

Journal reference: *Science*, DOI: 10.1126/science.1204994

http://www.newscientist.com/article/dn20987-air-pollution-is-stunting-indias-monsoon.html

Eating your greens alters your genes

- 29 September 2011 by **Ferris Jabr**
- Magazine issue 2832.

A forkful of medicine? *(Image: Getty)*

Editorial: "The good news about how food tweaks our genes"

CONSIDER the Brussels sprout: small, unassuming and ostensibly good for you. This is no mere side dish. A landmark study suggests that this dinky member of the cabbage family - along with rice, broccoli and possibly all the plants you eat - changes the behaviour of your genes in ways that are new to science.

In what is the strongest evidence yet that the genetic material in food survives digestion and circulates through the body, fragments of plant RNA have been found swimming in the bloodstreams of people and cows. What's more the study by Chen-Yu Zhang of Nanjing University in China and his colleagues shows that some of these plant RNAs muffle gene expression and raise cholesterol levels in mice. The discovery opens up a new way to turn food into medicine: we may be able to design plants that change our genes for the better.

The genetic material in question is microRNA - tiny strands of RNA between 19 and 24 "letters" or nucleotides long. It is found in almost all cells with a nucleus and travels from cell to cell in the blood. Zhang and his colleagues wondered whether all the miRNA strands in our blood are made by our cells - or whether some comes from our food instead.

To begin, the team drew blood from 31 healthy Chinese men and women, and also from cows. They treated the samples with sodium periodate, an oxidising agent that modifies mammalian miRNA so that it cannot be sequenced. Crucially, it leaves the plant versions untouched. Zhang found some 30 known plant miRNAs floating in the blood of the people and cows.

Two miRNAs were present in particularly high concentrations: MIR168a and MIR156a, which we will call 168a and 156a. They are abundant in rice and members of the Brassicaceae family, including the Brussels sprout, broccoli, cabbage and cauliflower. Surprisingly, Zhang found 168a and 156a in the livers, small intestines and lungs of mice. Given the prominence of rice in the Chinese diet - coupled with the fact that cooking does not destroy the plant miRNAs - Zhang concluded that those in the human blood samples came from food.

That plant miRNA survives digestion and circulates through the body was surprising enough. But Zhang wanted to know whether plant miRNA remains functional in animal blood.

Like a genetic volume control, miRNA muffles or amplifies gene expression by binding to strands of messenger RNA and preventing enzymes from translating the strands into a protein. To find out if 168a tweaks gene expression in animals, Zhang's team searched the human, rat and mice genomes for sequences that complemented 168a. They found around 50 genes that 168a might turn up or down, including the gene for LDLRAP1, a liver protein that removes "bad cholesterol" from the blood.

In a series of experiments, Zhang and the team found that not only does 168a survive in animal cells, it can also change gene expression. First, Zhang added 168a to a dish of human intestinal cells. The cells packaged the 168a into tiny bubbles and released them. Zhang poured these bubbles onto mammalian liver cells, which soon began producing unusually low levels of LDLRAP1.

Then Zhang fed mice raw rice or injected them with 168a, and found that levels of this protein dropped and levels of cholesterol rose. When he injected the mice with a genetic sequence designed to inactivate 168a, levels of the cholesterol-removing protein did not drop.

Together, the evidence suggests that, in mice at least, 168a from rice survives digestion, inhibits production of a protein and boosts cholesterol levels in the blood. Put simply, a plant miRNA is capable of raising cholesterol levels in mice (*Cell Research*, DOI: 10.1038/cr.2011.158).

Zhang is unsure how the miRNAs escape unscathed from the caustic soup of digestive fluids and enzymes in the gut. But substantial research suggests that not all genetic matter from food dissolves in the stomach and intestines. For instance, an essential photosynthesis gene found in soya bean leaves turned up in the intestines, liver and spleen of mice fed the leaves. And it was recently revealed that the hypnotically green sea slug *Elysia chlorotica* steals genes for photosynthesis from the algae it eats. Researchers also discovered that the bacteria in Japanese people's guts have sponged up genes from ocean bacteria that linger on seaweed.

Even if RNA or DNA does not pass unscathed from food to eater, food can change gene expression in other ways. For example, cosmetics researchers recently suggested that a pill containing a mix of food extracts can influence our genes and boost collagen production in the skin, reducing the appearance of wrinkles (*New Scientist*, 24 September, p 10).

If Zhang's findings are replicated, we may discover that our blood is swimming with RNA from all kinds of plants. To date, all investigation of this possibility has been motivated by concerns that genes from genetically modified crops could harm health (see "Let's talk about GM crops"). But the new study opens the possibility of designing diets and plants with therapeutic effects.

"You can bet this will create an absolute flurry of research activity" as scientists race to discover how genetic information in our food changes our health, says Ed Stellwag of East Carolina University in Greenville.

Peter Waterhouse of the University of Sydney, Australia, sees the potential for engineering medicinal plants but adds that for now this remains unchartered territory - mostly. Zhang is investigating whether miRNAs in a Chinese herb can knock out the influenza virus, but remains tight-lipped about the results.

"This will expand our idea of nutrients by including miRNA as functional component of food," says Moon-Suhn Ryu at the University of Florida in Gainesville. "This is going to introduce a new field of research, especially in nutritional science - it's such a novel concept."

Let's talk about GM crops

Do the genes firms insert into genetically modified crops change the health of people who eat them? We do not yet know the answer.

Biotech giant Monsanto inserted a bacterial gene into soya beans to make them resistant to herbicide, allowing farmers to spray their crops with potent weedkillers. One study asked whether this gene could pass to our gut bacteria. Of seven volunteers, three showed evidence of bacterial genes from the soya beans in their gut bacteria before the experiment began, but there was no evidence of similar transmission during the experiment.

Corn engineered to express the *cry1Ab* gene makes a toxin that kills insect larvae. One study found the gene in the intestines of pigs fed GM corn, but not in pigs fed unmodified corn. A 2009 study looked for modified genes and proteins in the milk of cows fed GM corn, but found nothing.

So the results are ambiguous. But there is a key difference between these studies and that of Chen-Yu Zhang (see "Eating greens alters genes"). Whereas earlier work offers no evidence that GM genes from food alter human physiology, Zhang's study suggests that all the plants we eat have been modifying our gene expression for as long as we have been eating them - a sobering thought.

http://www.newscientist.com/article/mg21128323.100-eating-your-greens-alters-your-genes.html

Epigenetic clue to schizophrenia and bipolar disorder

- Updated 11:12 30 September 2011 by **Andy Coghlan**
- Magazine issue 2832.

Same genes, different activity *(Image: Image Source/Getty)*

TWIN studies have shown that people with schizophrenia and bipolar disorder have changes in gene activity caused by their environment. The finding provides the strongest evidence yet that such gene changes might cause the conditions.

Jonathan Mill at the Institute of Psychiatry, King's College London, and colleagues scanned the genome of 22 pairs of identical twins - chosen because one twin in each pair was diagnosed with schizophrenia or bipolar disorder.

As expected, the twins had identical DNA. However, they showed significant differences in chemical "epigenetic" markings - changes that do not alter the sequence of DNA but leave chemical marks on genes that dictate how active they are. These changes were on genes that have been linked with bipolar disorder and schizophrenia.

Mill's team scanned for differences in the attachment of chemical methyl groups at 27,000 sites in the genome. Methylation normally switches genes off, and de-methylation turns them on.

Regardless of which condition the twin had, the most significant differences, with variations of up to 20 per cent in the amount of methylation, were in the promoter "switch" for a gene called *ST6GALNAC1*, which has been linked with schizophrenia. Although the function of the gene isn't fully established, it is thought to add sugars to proteins, which could alter the speed or specificity of their usual function.

The findings tallied with another study which involved screening post-mortem brain tissue from people who had had some form of psychosis. The researchers found differences of up to 25 per cent in methylation of the same gene compared with controls.

The twin scans also revealed methylation differences in *GPR24*, a gene previously linked to bipolar disorder. One gene, called *ZNF659*, showed over-methylation in people with schizophrenia and under-methylation in

those who were bipolar, suggesting that the conditions might result from opposing gene activity (*Human Molecular Genetics*, DOI: 10.1093/hmg/ddr416).

"We know these disorders are related, and there are clinical features shared by both," says Mill. "But our scan suggests there are some genes that might be overactive in one disease and underactive in the other."

Mill says twins would need to be scanned regularly throughout life to find out whether epigenetic changes precede the onset of the disorders. It might be possible then to link the alterations to environmental changes such as stressful events or diet, which have been shown to cause inheritable epigenetic changes in mice.

"I feel this is the best evidence yet, from human studies, supporting the hypothesis that epigenetic mechanisms may drive psychiatric disorders," says David Sweatt, who studies epigenetics at the University of Alabama and was not involved in the study.

http://www.newscientist.com/article/mg21128323.400-epigenetic-clue-to-schizophrenia-and-bipolar-disorder.html

Obesity expert: Sugar is toxic and should be regulated

- 28 September 2011 by **Tiffany O'Callaghan**
- Magazine issue 2831.

Exploring the dangers of sugary food

It might taste good, but sugar is addictive and fuelling the obesity epidemic, says ***Robert Lustig***

Your lecture on sugar has been viewed more than 1.6 million times on YouTube. Why do you think it's had so much attention?

The obesity epidemic just gets worse and people are looking for answers. Diet and exercise don't work and the idea that obesity is about personal responsibility has come into question. Many people have said sugar is bad, but they didn't supply the biochemistry. I supplied that.

Do you think fructose - which along with glucose makes table sugar - drives obesity?

I don't think fructose is the cause of obesity, but I do think it is the thing that takes you from obesity to metabolic syndrome, and that's where the healthcare dollars go - diabetes, hypertension and cardiovascular disease.

So the idea that "a calorie is a calorie" is wrong?

As far as I'm concerned that's how we got into this mess. If a calorie is a calorie, the solution is eat less and exercise more. Except it doesn't work. And the reason is that fructose is toxic beyond its caloric equivalent, so if you consume it instead of glucose you get more of a negative effect even if the calories are the same. It's important that people recognise that the quality of our diet also dictates the quantity. In addition, "eat less" is a really crappy message that doesn't work. "Eat less sugar" is a message that people can get their heads around.

Why do we consume so much sugar?

One reason is that it's addictive. The food industry knows that when they add fructose we buy more. That's why it's in everything. There are five tastes on your tongue: sweet, salty, sour, bitter and umami. Sugar covers

up the other four, so you can't taste the negative aspects of foods. You can make dog poop taste good with enough sugar. In essence, that is what the food industry has done.

You say that sugar is a chronic toxin. Why?

We have three levels of toxins: things like cyanide where one part per million will kill you; arsenic and lead where 30 to 50 parts per million kills you; and toxins where high doses of thousands of parts per million can kill you. A lot of the last category are nutrients, for instance vitamin A, vitamin D and iron. Well, fructose falls in that category.

You think fructose should be regulated. Why treat it differently to vitamin D or iron, say?

The difference is that for vitamin D and iron there is no abuse potential. With fructose there is. We don't regulate toxic substances that aren't abused. We don't regulate abuse substances that are not toxic, like caffeine. Where we get excited is where we have toxic substances that are also abused like cocaine, ethanol, heroin and nicotine. Well, fructose is a toxic substance that is also abused. By that analogy, we ought to regulate it.

Do you think sugar regulation will happen?

Obviously, no one is ready to do that. The question is how much more metabolic syndrome and diabetes do we need to see before we consider changing that policy? That's a decision for policymakers, but they can't make the decision without the science. I'm supplying the science.

Profile

Robert Lustig is professor of pediatrics at the University of California, San Francisco. His lecture, "Sugar: The bitter truth", explores the dangers of sugary food

http://www.newscientist.com/article/mg21128310.300-obesity-expert-sugar-is-toxic-and-should-be-regulated.html

Fermilab stops hunting Higgs, starts neutrino quest

- 28 September 2011 by **David Shiga**, Fermilab, Illinois and **Chelsea Whyte**
- Magazine issue 2832.

So long *(Image: Reidar Hahn/Fermilab)*

Once top dog, the Tevatron particle accelerator is shutting down – from now on, the US lab that houses it will focus on neutrinos

ROGER DIXON gestures, bringing his hand alarmingly close to the big red button that has the power to shut down one of the world's most powerful particle accelerators forever. "It's already hooked up," he says, in response to my nervous questions.

We are standing in a room full of blinking displays and control panels at Fermi National Laboratory (Fermilab), which nestles among cornfields outside Chicago. Dixon, who is in charge of the smooth running of the accelerator, the Tevatron, pulls his hand back.

Once king, the Tevatron is due to shut down on 30 September as it can no longer compete with the energies achieved by the Large Hadron Collider (LHC) at CERN near Geneva, Switzerland. "It is being superseded," admits Fermilab director Pier Oddone.

For years, Fermilab hoped the Tevatron would find the Higgs boson, the particle thought to endow all others with mass. It has not, and that task has now passed to the LHC. Instead the Tevatron will likely be remembered most for its discovery in 1995 of the top quark, the last of the six quarks in the standard model of particle physics to be seen. But just as the Higgs spotlight moves away from Fermilab, another, potentially equally exciting particle may thrust the lab into the limelight again.

Last week, the OPERA experiment rocked the foundations of physics when it reported subatomic particles called neutrinos apparently breaking the light-speed barrier (see "'Light-speed' neutrinos point to new physical reality"). As it turns out, Fermilab's existing neutrino experiment, MINOS, is well suited to confirming or ruling out this bizarre observation. MINOS fires neutrino beams of an energy similar to those detected at OPERA to a detector in the Soudan mine, 800 kilometres away in Minnesota.

Its first task will be to update a 2007 search for faster-than-light neutrinos, which didn't throw up anything statistically significant, using more recent data. That could be completed in six months, says MINOS collaborator Jenny Thomas of University College London. Meanwhile, the next incarnation, MINOS Plus, will have new GPS sensors, atomic clocks and detectors to record neutrino arrival time with a precision of 2 nanoseconds. This could deliver results as early as 2014.

In the absence of the Tevatron, neutrino physics will soon receive the bulk of Fermilab's resources, and focus on more than pure speed. A short drive from the Tevatron control room is a symbol of this shift - a black, brick-shaped structure the size of a school bus. It is part of the Nova experiment, which will begin in 2013.

Nova will study neutrinos' ability to morph, or "oscillate", from one type to another, looking for potential differences in the way neutrinos and their antimatter counterparts oscillate, which MINOS results hint at. In the early universe, the differences might have created a preponderance of matter over antimatter that would account for the universe's current composition.

"Neutrinos have been a source of big surprises in the past," says Oddone. "I don't think we're going to understand particle physics until we understand neutrinos."

Fermilab might yet come back with an accelerator to rival the LHC. In a brightly lit laboratory with gleaming white floors, I glimpse what looks like a stack of silver doughnuts. Made of pure niobium, this bumpy tube will be superconducting when chilled to near absolute zero in a bath of liquid helium. If 16,000 tubes can be lined end to end, they will form an accelerator called the International Linear Collider. The electrons and positrons it smashes together will have a collision energy of 1 teraelectronvolt. That's a fraction of the LHC's 7 TeV, but if the LHC discovers the Higgs, say, the ILC should be able to measure its mass and other properties more precisely.

As the Tevatron's last day approaches, few here seem sentimental. Fermilab helped make the Tevatron obsolete, after all, by building some of the LHC's magnets and contributing to one of its two main detectors. "It's a bittersweet moment," says Oddone. "It has been quite a wonderful life for the Tevatron. But you don't stay at the leading edge unless you build new things."

http://www.newscientist.com/article/mg21128323.000-fermilab-stops-hunting-higgs-starts-neutrino-quest.html

Subversive apps help citizens fight state silencing

- 17 September 2011 by **Kat Austen**
- Magazine issue 2830.

(Image: Trevor Snapp/Corbis)

WHEN the Egyptian authorities realised protesters were using the internet to organise themselves in January, they came up with a simple solution: in an instant they disconnected the nation, cutting off anti-government dissidents from an invaluable resource.

The outage inspired James Burke and Chris Pinchen - both members of the P2P Foundation, a group that monitors how data is shared online - to begin work on the ChokePoint Project. The idea is to compile a real-time interactive map of the entire internet and identify potential choke points - the physical and virtual locations where internet access could be easily compromised - and who has the power to strangle them.

ChokePoint Project's map would allow people to identify the degree and exact location of a network outage, says Burke. So, even if a country's access to social networks, or the entire internet, is lost, people would have a better chance of circumventing network blockades - either by routeing through open paths, or by using services located abroad, such as Telecomix, which converts messages sent to fax machines into emails.

"With every country in the world sending network data, over time we'll see the trends of big data patterns," says Burke, comparing the idea to the patterns observable in financial data.

That's a way off yet. The project, which began in March, is still in its early stages, though the team was recently awarded a small development grant at the Ars Electronica technology festival.

Burke says care is needed when mapping networks in regimes where the people who supply data could be arrested. As much of the data would be supplied by volunteers, it is crucial that the transfer of data is invisible. The team's partners are writing software, to be launched later this year, which will both hide data transfer and anonymise its source. All code will be made open source.

Internet blocks became increasingly sophisticated and less easy to detect as the Arab Spring progressed. In Egypt, it was immediately obvious when border gateway protocols (BGP) were turned off. However, when trouble arose in Libya, traffic through the country's one internet service provider was only slowed down; so

the effective outage went under the international radar for a whole day. A real-time map would allow the world to keep track of what is happening in an affected country.

ChokePoint is not the only website or app designed to help citizens fight back. As well as using standard social media, such as Twitter and Facebook, political activists make use of live audio and video streaming sites, including Audioboo and Bambuser, to keep the world up to date with news from the front line. To help citizens communicate in the thick of it, earlier this year saw the launch of Sukey, a website and app that allows activists to update the location of police during protests.

Armchair activism has not been left behind. A Chilean non-profit organisation, the Intelligent Citizen Foundation, has a series of apps that allow the public to identify possible cases of political corruption, including one that makes it easier to request information that would normally be difficult to get hold of.

http://www.newscientist.com/article/mg21128305.800-subversive-apps-help-citizens-fight-state-silencing.html

It knows

Daniel Soar

- *The Googlisation of Everything (and Why We Should Worry)* by Siva Vaidhyanathan
  California, 265 pp, £18.95, March 2011, ISBN 978 0 520 25882 2
- *In the Plex: How Google Thinks, Works and Shapes Our Lives* by Steven Levy
  Simon and Schuster, 424 pp, £18.99, May 2011, ISBN 978 1 4165 9658 5
- *I'm Feeling Lucky: The Confessions of Google Employee Number 59* by Douglas Edwards
  Allen Lane, 416 pp, £20.00, July 2011, ISBN 978 1 84614 512 4

This spring, the billionaire Eric Schmidt announced that there were only four really significant technology companies: Apple, Amazon, Facebook and Google, the company he had until recently been running. People believed him. What distinguished his new 'gang of four' from the generation it had superseded – companies like Intel, Microsoft, Dell and Cisco, which mostly exist to sell gizmos and gadgets and innumerable hours of expensive support services to corporate clients – was that the newcomers sold their products and services to ordinary people. Since there are more ordinary people in the world than there are businesses, and since there's nothing that ordinary people don't want or need, or can't be persuaded they want or need when it flashes up alluringly on their screens, the money to be made from them is virtually limitless. Together, Schmidt's four companies are worth more than half a trillion dollars. The technology sector isn't as big as, say, oil, but it's growing, as more and more traditional industries – advertising, travel, real estate, used cars, new cars, porn, television, film, music, publishing, news – are subsumed into the digital economy. Schmidt, who as the ex-CEO of a multibillion-dollar corporation had learned to take the long view, warned that not all four of his disruptive gang could survive. So – as they all converge from their various beginnings to compete in the same area, the place usually referred to as 'the cloud', a place where everything that matters is online – the question is: who will be the first to blink?

If the company that falters is Google, it won't be because it didn't see the future coming. Of Schmidt's four technology juggernauts, Google has always been the most ambitious, and the most committed to getting everything possible onto the internet, its mission being 'to organise the world's information and make it universally accessible and useful'. Its ubiquitous search box has changed the way information can be got at to such an extent that ten years after most people first learned of its existence you wouldn't think of trying to find out anything without typing it into Google first. Searching on Google is automatic, a reflex, just part of what we do. But an insufficiently thought-about fact is that in order to organise the world's information Google first has to get hold of the stuff. And in the long run 'the world's information' means much more than anyone would ever have imagined it could. It means, of course, the totality of the information contained on the World Wide Web, or the contents of more than a trillion webpages (it was a trillion at the last count, in 2008; now, such a number would be meaningless). But that much goes without saying, since indexing and ranking webpages is where Google began when it got going as a research project at Stanford in 1996, just five years after the web itself was invented. It means – or would mean, if lawyers let Google have its way – the complete contents of every one of the more than 33 million books in the Library of Congress or, if you include slightly varying editions and pamphlets and other ephemera, the contents of the approximately 129,864,880 books published in every recorded language since printing was invented. It means every video uploaded to the public internet, a quantity – if you take the Google-owned YouTube alone – that is increasing at the rate of nearly an hour of video every second.

It means the location of businesses, religious institutions, schools, libraries, community centres and hospitals worldwide – a global Yellow Pages. It means the inventories of shops, the archives of newspapers, the minute by minute performance of the stock market. It means, or will mean, if Google keeps going, the exact look of every street corner and roadside on the planet, photographed in high resolution and kept as up to date as possible: the logic, if not yet the practice, of Google Street View, means that city streets should be under ever more regular photographic surveillance, since the fresher and more complete the imagery the more useful

people will find it, and the more they will therefore use it.[1] If it doesn't already have a piece of data, you can be sure that Google is pursuing a way of getting it, of gathering and sorting every kind of public information there is.

But all this is just the stuff that Google makes publicly searchable, or 'universally accessible'. It's only a small fraction of the information it actually possesses. I know that Google knows, because I've looked it up, that on 30 April 2011 at 4.33 p.m. I was at Willesden Junction station, travelling west. It knows where I was, as it knows where I am now, because like many millions of others I have an Android-powered smartphone with Google's location service turned on. If you use the full range of its products, Google knows the identity of everyone you communicate with by email, instant messaging and phone, with a master list – accessible only by you, and by Google – of the people you contact most. If you use its products, Google knows the content of your emails and voicemail messages (a feature of Google Voice is that it transcribes messages and emails them to you, storing the text on Google servers indefinitely). If you find Google products compelling – and their promise of access-anywhere, conflagration and laptop-theft-proof document creation makes them quite compelling – Google knows the content of every document you write or spreadsheet you fiddle or presentation you construct. If as many Google-enabled robotic devices get installed as Google hopes, Google may soon know the contents of your fridge, your heart rate when you're exercising, the weather outside your front door, the pattern of electricity use in your home.

Google knows or has sought to know, and may increasingly seek to know, your credit card numbers, your purchasing history, your date of birth, your medical history, your reading habits, your taste in music, your interest or otherwise (thanks to your searching habits) in the First Intifada or the career of Audrey Hepburn or flights to Mexico or interest-free loans, or whatever you idly speculate about at 3.45 on a Wednesday afternoon. Here's something: if you have an Android phone, Google can guess your home address, since that's where your phone tends to be at night. I don't mean that in theory some rogue Google employee could hack into your phone to find out where you sleep; I mean that Google, as a system, explicitly deduces where you live and openly logs it as 'home address' in its location service, to put beside the 'work address' where you spend the majority of your daytime hours.

Some people find all this frightening. Since Google still makes more than 95 per cent of its money through selling advertising – that's $30 billion a year, or about twice the annual global revenue of the entire recorded music industry – the fear is that all the information about us it has hoovered up is used to create scarily exact user profiles which it then offers to advertisers, as the most complete picture of billions of individuals it's currently possible to build. The fear seems be based on the assumption that if Google is gathering all this information then it must be doing so in order to sell it: it is a profit-making company, after all. 'We are not Google's customers,' Siva Vaidhyanathan writes in *The Googlisation of Everything*. 'We are its product. We – our fancies, fetishes, predilections and preferences – are what Google sells to advertisers.' Vaidhyanathan, who likes alliteration but isn't so big on facts, doesn't explain what he means by 'sells' (or whether 'to sell a fancy' could mean anything at all), but if he's implying that Google makes the information it has about us available to advertisers then he's wrong. It isn't possible, using Google's tools, to target an ad to 32-year-old single heterosexual men living in London who work at Goldman Sachs and like skiing, especially at Courchevel. You can do exactly that using Facebook, but the options Google gives advertisers are, by comparison, limited: the closest it gets is to allow them to target display ads to people who may be interested in the category of 'skiing and snowboarding' – and advertisers were always able to do that anyway by buying space in *Ski & Snowboard* magazine. The rest of the time, Google decides the placement of ads itself, using its proprietary algorithms to display them wherever it knows they will get the most clicks. The advertisers are left out of the loop.

So why doesn't Google market its personal information, when it has so much of it? One answer might be that to do so would be 'evil'. 'Don't be evil' is Google's geeky corporate motto – a hostage to fortune if ever there was one, though it usually seems to mean 'don't do anything to upset the users.' We'd be upset – we might even choose to use a competing service – if Google released information about us that we didn't know it had,

or that we didn't even know ourselves, such as the likelihood, revealed by our searches, that we might be suffering from a particular illness.[2] Facebook gets away with being evil – or does it? – because the personal information it makes available for targeting is information that users have voluntarily surrendered by filling in their profiles: birthday, relationship status, hometown, workplace; every time they click on a 'Like' button on the web they are deemed to have declared an interest that can be used for targeting. But another answer might be that the information Google has is too valuable to give away, that it has another reason for collecting every piece of data it possibly can, that the stuff it's amassing is worth more than just money.

The reason is that Google is learning. The more data it gathers, the more it knows, the better it gets at what it does. Of course, the better it gets at what it does the more money it makes, and the more money it makes the more data it gathers and the better it gets at what it does – an example of the kind of win-win feedback loop Google specialises in – but what's surprising is that there is no obvious end to the process. Thanks to what it has learned so far, Google is no longer the merely impressive search engine it was a decade ago. Back then, it was assumed that the key to its success in delivering its (as it once seemed) uncannily accurate results was its first and best-known invention, PageRank, the algorithm that assigns to every page on the web a value indicating how authoritative it is, based on the number and the authoritativeness of the pages linking to it. Its inventor was Larry Page (hence, cunningly, PageRank), one of Google's founders and now once more its CEO; and his model, as Steven Levy explains in *In the Plex*, was the system of scholarly citation, by which journal articles and books are considered important if they are referred to by other important journal articles and books. Levy is big on origins. Not everyone will think much of the suggestion that Page and Sergey Brin, his co-founder, got where they are today because they were both 'Montessori kids' who were taught from an early age to believe anything was possible.[3] But he may be on to something when he says that Page's academic family background – his father taught at Michigan State, and he hung out at Stanford as a child – meant that when he faced the problem of how to rank importance he recognised that the economy of the web was very similar to the economy of academia. Those at the bottom of the ladder (the junior academics, the lowly website owners) seek recognition from those above them (the celebrated professors, the global internet portals) and use citations in the hope that some of the gold dust will rub off on them if they get cited back. Rankings based on citations aren't necessarily a measure of excellence – if they were, we wouldn't hear so much about Steven Pinker – but they do reflect where humans have decided that authority lies.

PageRank, however, has always been just one of the factors determining how Google's search results are ordered. In 2007, Google told the *New York Times* that it was now using more than 200 signals in its ranking algorithm, and the number must now be higher. What every one of those signals is and how they are weighted is Google's most precious trade secret, but the most useful signal of all is the least predictable: the behaviour of the person who types their query into the search box. A click on the third result counts as a vote that it ought to come higher. A 'long click' – when you select one of the results and don't come back – is a stronger vote. To test a new version of its algorithm, Google releases it to a small subset of its users and measures its effectiveness through the pattern of their clicks: more happy surfers and it's just got cleverer. We teach it while we think it's teaching us. Levy tells the story of a new recruit with a long managerial background who asked Google's senior vice-president of engineering, Alan Eustace, what systems Google had in place to improve its products. 'He expected to hear about quality assurance teams and focus groups' – the sort of set-up he was used to. 'Instead Eustace explained that Google's brain was like a baby's, an omnivorous sponge that was always getting smarter from the information it soaked up.' Like a baby, Google uses what it hears to learn about the workings of human language. The large number of people who search for 'pictures of dogs' and also 'pictures of puppies' tells Google that 'puppy' and 'dog' mean similar things, yet it also knows that people searching for 'hot dogs' get cross if they're given instructions for 'boiling puppies'. If Google misunderstands you, and delivers the wrong results, the fact that you'll go back and rephrase your query, explaining what you mean, will help it get it right next time. Every search for information is itself a piece of information Google can learn from.

By 2007, Google knew enough about the structure of queries to be able to release a US-only directory inquiry service called GOOG-411. You dialled 1-800-4664-411 and spoke your question to the robot operator, which parsed it and spoke you back the top eight results, while offering to connect your call. It was free, nifty and

widely used, especially because – unprecedentedly for a company that had never spent much on marketing – Google chose to promote it on billboards across California and New York State. People thought it was weird that Google was paying to advertise a product it couldn't possibly make money from, but by then Google had become known for doing weird and pleasing things. In 2004, it launched Gmail with what was for the time an insanely large quota of free storage – 1GB, five hundred times more than its competitors. But in that case it was making money from the ads that appeared alongside your emails. What was it getting with GOOG-411? It soon became clear that what it was getting were demands for pizza spoken in every accent in the continental United States, along with questions about plumbers in Detroit and countless variations on the pronunciations of 'Schenectady', 'Okefenokee' and 'Boca Raton'. GOOG-411, a Google researcher later wrote, was a phoneme-gathering operation, a way of improving voice recognition technology through massive data collection.

Three years later, the service was dropped, but by then Google had launched its Android operating system and had released into the wild an improved search-by-voice service that didn't require a phone call. You tapped the little microphone icon on your phone's screen – it was later extended to Blackberries and iPhones – and your speech was transmitted via the mobile internet to Google servers, where it was interpreted using the advanced techniques the GOOG-411 exercise had enabled. The baby had learned to talk. Now that Android phones are being activated at a rate of more than half a million a day,[4] Google suddenly has a vast and growing repository of spoken words, in every language on earth, and a much more powerful learning machine. If your phone mistranscribes what you say, you correct it by typing it in, and Google's algorithms – once again – are taught how to get better still. It's a frustratingly faultless learning loop. It's easy to assume that the end result of this increasing perfection will be a Google machine in the cloud that can correctly transcribe all speech in all languages from Afrikaans to Xhosa, however badly you mumble: useful when you're driving or have your hands full. But that's to think small.

Before Google bought YouTube in 2006 for $1.65 billion, it had a fledgling video service of its own, predictably called Google Video, that in its initial incarnation offered the – it seemed – brilliant feature of answering a typed phrase with a video clip in which those words were spoken. The promise was that, for example, you'd be able to search for the phrase 'in my beginning is my end' and see T.S. Eliot, on film, reciting from the *Four Quartets*. But no such luck. Google Video's search worked by a kind of trickery: it used the hidden subtitles that broadcasters provide for the hard of hearing, which Google had generally paid to use, and searched against the text. The service is just one of the many experiments that Google over the years has killed, but a presumably large reason for its death was that although it appeared to work it was really very limited. Not everything is tailored for the deaf, and subtitles are often wrong. If, however, Google is able to deploy its newly capable voice recognition system to transcribe the spoken words in the two days' worth of video uploaded to YouTube every minute, there would be an explosion in the amount of searchable material. Since there's no reason Google can't do it, it will.

A thought experiment: if Google launched satellites into orbit it could record all terrestrial broadcasts and transcribe those too. That may sound exorbitant, but it's not obviously crazier than some of the ideas that Google's founders have dreamed up and found a way of implementing: the idea of photographing all the world's streets, of scanning all the world's books, of building cars that drive themselves. It's the sort of thing that crosses Google's mind. An April Fool's joke a few years ago advertised job opportunities at Google's research centre on the Moon, where listening equipment would provide an 'ear on the chatter of the universe, the vast web of electromagnetic pulses that may contain signals from intelligent life forms in other galaxies, as well as a complete record of every radio or television signal broadcast from our own planet'. Google takes its April Fool's jokes very seriously, as the marketing man who wrote some of them, Douglas Edwards, explains in *I'm Feeling Lucky: The Confessions of Google Employee Number 59*: big arguments broke out when the founders felt that proposed jokes weren't true to Google's sense of its mission. The jokes – like the friendly logo, and the homepage doodles – are carefully designed to hint at the scale of Google's ambition without scaring the world to death.

There seem to be no large Google initiatives – however seemingly tangential to the company's core competency, and unhelpful to its bottom line – that don't bring as a side benefit, or as the main benefit, an enormous amount of data to Google. They also threaten to put whole industries out of business by being free. In 2009, Google updated its Maps application for Android to include free turn-by-turn navigation: on-screen and spoken directions to whatever destination you choose. The cost to Google was negligible, and the damage to existing businesses was enormous: companies like Garmin and TomTom had been getting large margins on hundred-pound satnav hardware, and then charging for monthly subscriptions. Not any more. Naturally, those threatened don't always give up without a fight. That a more esoteric battle has been taking place over Android was revealed earlier this year when a little company called Skyhook took Google to court for alleged unfair business practices. Skyhook makes its money by licensing location-detection technology to hardware manufacturers, and – in an impressive coup – had succeeded in persuading Motorola, among others, that its system was better than Google's. Motorola agreed to pay to use Skyhook's service on its Android phones in preference to Google's built-in free one. When Google executives found out what had happened – as subpoenaed emails between them showed – they were incredulous, and alarmed:

This feels like a disaster :(

I think this is worth a postmortem and maybe a code yellow or something like that to really focus here.

What they were alarmed about was not that their system might not be the best – they didn't quite believe that – but that if manufacturers started using a competitor's product they would no longer be getting the data they needed to improve their own.[5] In other words, Google faced the unfamiliar problem of the negative feedback loop: the fewer people that used its product, the less information it would have and the worse the product would get. So the executives swung into action and reminded Motorola of various contractual obligations that went with the Android licence. Google got to keep its data. Coincidentally, last month, it announced its plan to buy Motorola Mobility – along with 19,000 employees, nearly doubling Google's workforce – for $12.5 billion.

Google isn't invincible. Eric Schmidt likes to say that its competitors are only one click away: if you don't like Google's search results, or its business practices, you can always use Bing. But Google is currently facing anti-trust scrutiny by Senate subcommittees, and the bigger it gets the less answerable the regulatory threat will become. Google is getting cleverer precisely because it is so big. If it's cut down to size then what will happen to everything it knows? That's the conundrum. It's clearly wrong for all the information in all the world's books to be in the sole possession of a single company. It's clearly not ideal that only one company in the world can, with increasing accuracy, translate text between 506 different pairs of languages. On the other hand, if Google doesn't do these things, who will?

[1] In 1999, Google's web index – its copy of every page on the internet – was updated once every three or four months. By 2003 parts of the index were updated once a day, and by 2007 the rate was once every few minutes. By 2009 it was no longer possible to say that the web was being crawled at such and such a speed: if Google considered there was a chance a page might be updated it engineered things such that any change on that page was reflected in its index exactly as it happened. A search for 'hudson river' on 15 January 2009 would have showed that a plane had crash-landed on it before it was reported by CNN.

[2] This is something that Google can in theory know. Google Flu Trends uses aggregated search data for flu-like symptoms to estimate the spread of flu pandemics in various countries around the world. Google published an article in *Nature* explaining its methodology ('we applied the Fisher Z-transformation to each correlation, and took the mean of the 36 Z-transformed correlations'), and demonstrated that its tool was as accurate as any existing method of estimating flu levels at any given moment and, since it doesn't depend on health departments' weekly reports, much faster at providing results.

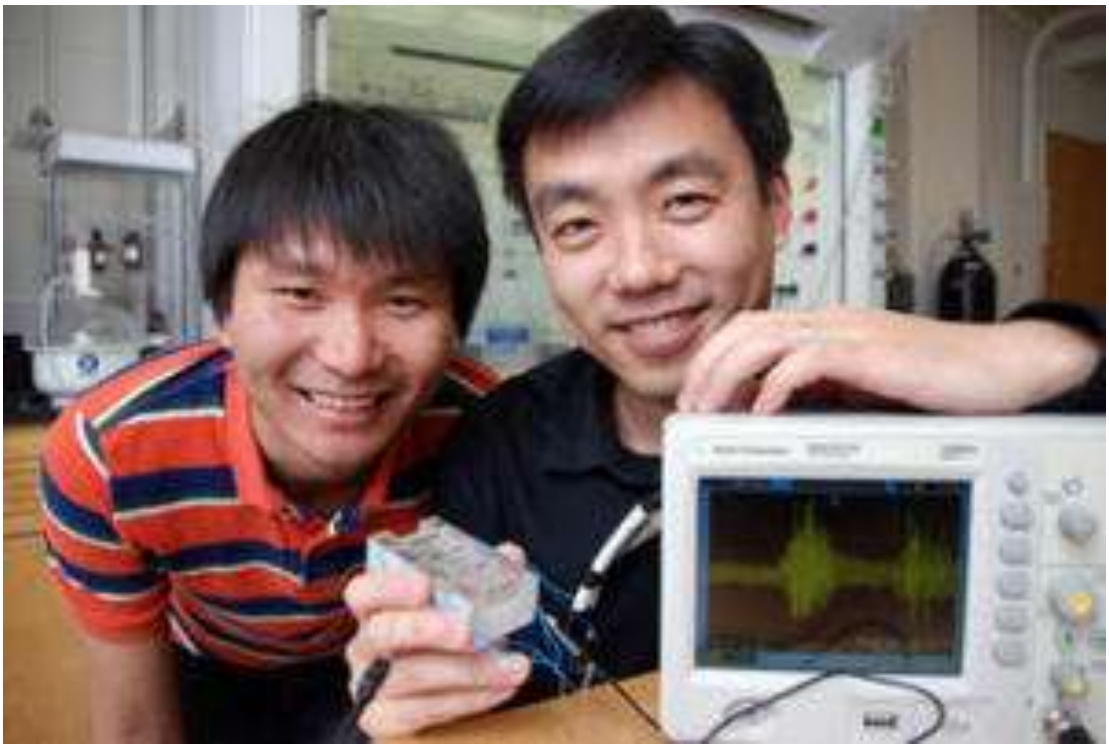
[3] As further evidence of Page's thinking big, Levy reports a conversation from 2003, when Google executives were discussing opening engineering offices overseas. 'Schmidt asked Page how quickly he would like to grow. "How many engineers does Microsoft have?" Page asked. About 25,000, he was told. "We should have a million."'

[4] Android's very rapid growth can mostly be attributed to the fact that the operating system is free for manufacturers to license. Previously, a handset-maker such as Nokia either had to develop its own software or pay large sums to use software developed by another company, such as Microsoft. In fact, Android is what is known as 'less than free', since manufacturers get an undisclosed percentage of Google's ad revenue from phones Android is installed on.

[5] In 2010, Google had been forced by regulators to stop its Street View cars from collecting certain location data after it was discovered that they were (Google says) accidentally also recording some of the data transmitted through WiFi networks in people's homes. One of the emails in the Skyhook lawsuit explained that now that Google was no longer getting location data from Street View cars it relied heavily on the data from Android handsets 'to maintain and improve' its location service. It was a revealing indication of how ingeniously Google projects serve multiple ends.

http://www.lrb.co.uk/v33/n19/daniel-soar/it-knows

Electricity from the Nose: Engineers Make Power from Human Respiration



Graduate Student Jian Shi and Materials Science and Engineering Professor Xudong Wang demonstrate a material that could be used to capture energy from respiration. (Credit: Image courtesy of University of Wisconsin-Madison, College of Engineering)

ScienceDaily (Oct. 8, 2011) — The same piezoelectric effect that ignites your gas grill with the push of a button could one day power sensors in your body via the respiration in your nose.

Writing in the September issue of the journal *Energy and Environmental Science*, Materials Science and Engineering Professor Xudong Wang, postdoctoral Researcher Chengliang Sun and graduate student Jian Shi report creating a plastic microbelt that vibrates when passed by low-speed airflow such as human respiration.

In certain materials, such as the polyvinylidene fluoride (PVDF) used by Wang's team, an electric charge accumulates in response to applied mechanical stress. This is known as the piezoelectric effect. The researchers engineered PVDF to generate sufficient electrical energy from respiration to operate small electronic devices.

"Basically, we are harvesting mechanical energy from biological systems. The airflow of normal human respiration is typically below about two meters per second," says Wang. "We calculated that if we could make this material thin enough, small vibrations could produce a microwatt of electrical energy that could be useful for sensors or other devices implanted in the face."

Researchers are taking advantage of advances in nanotechnology and miniaturized electronics to develop a host of biomedical devices that could monitor blood glucose for diabetics or keep a pacemaker battery charged so that it would not need replacing. What's needed to run these tiny devices is a miniscule power supply. Waste energy in the form or blood flow, motion, heat, or in this case respiration, offers a consistent source of power.

Wang's team used an ion-etching process to carefully thin material while preserving its piezoelectric properties. With improvements, he believes the thickness can be controlled down to the submicron level. Because PVDF is biocompatible, he says the development represents a significant advance toward creating a practical micro-scale device for harvesting energy from respiration.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Wisconsin-Madison, College of Engineering**.

Journal Reference:

1. Chengliang Sun, Jian Shi, Dylan J. Bayerl, Xudong Wang. **PVDF microbelts for harvesting energy from respiration**. *Energy & Environmental Science*, 2011; DOI: 10.1039/C1EE02241E

http://www.sciencedaily.com/releases/2011/10/111003234642.htm

Reefs Recovered Faster After Mass Extinction Than First Thought

Reef-forming sponges, Early Triassic era. (Credit: Image courtesy of University of Zurich)

ScienceDaily (Oct. 8, 2011) — Metazoan-dominated reefs only took 1.5 million years to recover after the largest species extinction 252 million years ago, an international research team including paleontologists from the University of Zurich has established based on fossils from the southwestern United States.

Harsh living conditions caused by major fluctuations in the carbon content and sea levels, overacidification and oxygen deficiency in the seas triggered the largest mass extinction of all time at the end of the Permian era 252 million years ago. Life on Earth was also anything but easy after the obliteration of over 90 percent of all species: Throughout the entire Early Triassic era, metazoan-dominated reefs were replaced by microbial deposits. Researchers had always assumed it took Earth as long as five million years to recover from this species collapse.

Now, however, an international team, including the paleontologist Hugo Bucher from the University of Zurich and his team of researchers, has shown that reefs already existed again in the southwest of what is now the USA 1.5 million years after the mass extinction. These were dominated by metazoan organisms such as sponges, serpulids and other living creatures, the researchers report in *Nature Geoscience.*

Growth thanks to new reef-forming metazoan organisms

Metazoan-dominated reefs already developed during the Early Triassic, much earlier than was previously assumed. As soon as the environmental conditions more or less returned to normal, the reef began to grow again due to metazoan organisms that had played a secondary role in reefs up to then. "This shows that, after the extinction of dominant reef creators, metazoan were able to form reef ecosystems much sooner than was previously thought," says Hugo Bucher, summing up the new discovery.

Story Source:

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

Journal Reference:

1. Arnaud Brayard, Emmanuelle Vennin, Nicolas Olivier, Kevin G. Bylund, Jim Jenks, Daniel A. Stephen, Hugo Bucher, Richard Hofmann, Nicolas Goudemand, Gilles Escarguel. **Transient metazoan reefs in the aftermath of the end-Permian mass extinction**. *Nature Geoscience*, 2011; 4 (10): 693 DOI: 10.1038/NGEO1264

http://www.sciencedaily.com/releases/2011/09/110930102802.htm

Inflating the Software Report Card

By TRIP GABRIEL and MATT RICHTEL

The Web site of Carnegie Learning, a company started by scientists at Carnegie Mellon University that sells classroom software, trumpets this promise: "Revolutionary Math Curricula. Revolutionary Results."

The pitch has sounded seductive to thousands of schools across the country for more than a decade. But a review by the United States Department of Education last year would suggest a much less alluring come-on: Undistinguished math curricula. Unproven results.

The federal review of Carnegie Learning's flagship software, Cognitive Tutor, said the program had "no discernible effects" on the standardized test scores of high school students. A separate 2009 federal look at 10 major software products for teaching algebra as well as elementary and middle school math and reading found that nine of them, including Cognitive Tutor, "did not have statistically significant effects on test scores."

Amid a classroom-based software boom estimated at $2.2 billion a year, debate continues to rage over the effectiveness of technology on learning and how best to measure it. But it is hard to tell that from technology companies' promotional materials.

Many companies ignore well-regarded independent studies that test their products' effectiveness. Carnegie's Web site, for example, makes no mention of the 2010 review, by the Education Department's What Works Clearinghouse, which analyzed 24 studies of Cognitive Tutor's effectiveness but found that only four of those met high research standards. Some firms misrepresent research by cherry-picking results and promote surveys or limited case studies that lack the scientific rigor required by the clearinghouse and other authorities.

"The advertising from the companies is tremendous oversell compared to what they can actually demonstrate," said Grover J. Whitehurst, a former director of the Institute of Education Sciences, the federal agency that includes What Works.

School officials, confronted with a morass of complicated and sometimes conflicting research, often buy products based on personal impressions, marketing hype or faith in technology for its own sake.

"They want the shiny new one," said Peter Cohen, chief executive of Pearson School, a leading publisher of classroom texts and software. "They always want the latest, when other things have been proven the longest and demonstrated to get results."

Carnegie, one of the most respected of the educational software firms, is hardly alone in overpromising or misleading. The Web site of Houghton Mifflin Harcourt says that "based on scientific research, Destination Reading is a powerful early literacy and adolescent literacy program," but it fails to mention that it was one of the products the Department of Education found in 2009 not to have statistically significant effects on test scores.

Similarly, Pearson's Web site cites several studies of its own to support its claim that Waterford Early Learning improves literacy, without acknowledging the same 2009 study's conclusion that it had little impact.

And Intel, in a Web document urging schools to buy computers for every student, acknowledges that "there are no longitudinal, randomized trials linking eLearning to positive learning outcomes." Yet it nonetheless argues that research shows that technology can lead to more engaged and economically successful students, happier teachers and more involved parents.

"To compare this public relations analysis to a carefully constructed research study is laughable," said Alex Molnar, professor of education at the National Education Policy Center at the University of Colorado. "They are selling their wares."

Carnegie officials say 600,000 students in 44 states use its products, many taking teacher-led classes three times a week with Carnegie-provided workbooks and spending the other two class periods in computer labs using Cognitive Tutor. The full curriculum can cost nearly three times as much as a typical textbook over six years.

Officials declined to release annual revenue figures, but Carnegie Learning was acquired in August for $75 million by the parent of the for-profit University of Phoenix. Carnegie Mellon University, which had retained ownership of the Cognitive Tutor software and licensed it to Carnegie Learning, earned an additional $21.5 million from the sale.

Steve Ritter, a founder and the chief scientist of Carnegie Learning, said there were flaws in the What Works Clearinghouse evaluations of Cognitive Tutor and disputed the Education Department's judgment of what makes a worthy study.

"What you want to focus on is more of the why," he said, "and less of a horse race to find out what works and doesn't."

A Carnegie spokeswoman, Mary Murrin, said in a statement that the company used "the data from all studies with varying outcomes to continuously improve our programs."

Karen Billings, a vice president of the Software and Information Industry Association — a trade group representing many education companies — said the problem was not that companies overpromise, but that

schools often do not properly deploy the products or train teachers to use them. Ms. Billings's group helped design the field trials, in 132 schools, for the landmark 2009 government study of 10 software products, which was ordered by Congress and cost $15 million.

Then came the deflating results. The industry "became very hostile," recalled Mr. Whitehurst, now director of education policy at the Brookings Institution. "It seems to me," he added, " 'hypocrisy' is the right word for loving something until the results are not what you expect."

The Hard Sell

Shelly Allen, the math coordinator for public schools in Augusta, Ga., has seen a lot of curriculum salespeople pass through. She is wary of their sweet words and hard sell.

In June, when representatives from Carnegie Learning visited, Dr. Allen warned: "I just want everybody to know I grew up here. I graduated from here. My children go to school here. When you guys get back where you live, our kids have to still be able to reach goals we set."

Augusta is famous for its magnolia-shaded National Golf Club, host to the Masters Tournament, but its public schools are typical of struggling urban districts. Three-quarters of the 32,000 students in the district, Richmond County, are black, and 72 percent are poor enough to qualify for the federal lunch program. The mean SAT math score last year was 443, below Georgia's mean of 490 and the nation's 516.

Six years ago, the district adopted Cognitive Tutor for about 3,000 students at risk of failing, paying $101,500 annually to use it. As students work through problems, the computer analyzes their weaknesses and serves up new items until they grasp the skill and are allowed to move on. To a student, the promotional materials say, it feels "as if the software is getting to know her and supporting her like a tutor."

So when the screen says: "You are saving to buy a bicycle. You have $10, and each day you are able to save $2," the student must convert the word problem into an algebraic expression. If he is stumped, he can click on the "Hint" button.

"Define a variable for the time from now," the software advises. Still stumped? Click "Next Hint."

"Use x to represent the time from now." Aha. The student types "2x+10."

The software likes this and moves on to highlight a series of questions in green, beginning with, "How many more days must you save to buy a bike that costs $60?" Using his 2x+10 formula, the student enters "25."

After solving several questions of this sort and plotting them on a graph, the student would click "Skillometer" to see how he had fared. A series of forest-green bars would show that he did well labeling axes for his graph, but not so well writing the initial formula.

Moving on, Cognitive Tutor would bump him down to an easier problem: "A skier noticed that he can complete a run in about 30 minutes (half an hour)." The expression relating ski runs to time would be 2x, with x representing hours.

"Immediate feedback," Carnegie Learning explains on its Web site, "enables the student to self-correct and leads to more effective learning."

Augusta officials liked the program enough that when concerns arose last winter that many 11th graders were not on track to pass a new state graduation test, the district asked to expand the software's use to all 9,400 of its high school students. The company agreed to provide access for no additional charge — temporarily.

"As a company, it makes sense to give you the opportunity to prove it works for all students," Anita Sprayberry, a regional sales manager, told school leaders. That way, she said, "We can talk about a bigger sale."

Going forward, Ms. Sprayberry said, the cost would be about $34,000 for each of the district's 11 high schools.

In a recent interview, Dr. Allen said she was familiar with the What Works Clearinghouse, but not its 2010 finding that Cognitive Tutor did not raise test scores more than textbooks.

Though the clearinghouse is intended to help school leaders choose proven curriculum, a 2010 Government Accountability Office survey of district officials found that 58 percent of them had never heard of What Works, never mind consulted its reviews.

"Decisions are made on marketing, on politics, on personal preference," said Robert A. Slavin, director of the Center for Research and Reform in Education at Johns Hopkins University. "An intelligent, caring principal who'd never buy a car without looking at Consumer Reports, when they plunk down serious money to buy a curriculum, they don't even look at the evidence."

Evaluating Curriculums

Founded in 1998 by cognitive and computer scientists along with math teachers, Carnegie Learning is proud of its academic heritage, and many education researchers consider it a model of rigor and transparency.

One founder, John R. Anderson, received the 2011 Benjamin Franklin Medal in Computer and Cognitive Science for work on how humans perceive, learn and reason. The company's Web site promises that its curriculums "provide the research-based foundation for proven results," citing "success stories" from around the country.

At Dundalk Middle School in Baltimore County, Md., for example, Carnegie Learning says that Cognitive Tutor led to an increase in the passing rate on a state assessment, to 86 percent in 2004 from 49 percent in 2002. What it does not say is that the rate remained at 85 percent last year, even though Dundalk dropped Cognitive Tutor in 2007 because of difficulties arranging lab time.

That is why many academics dismiss case studies: it is too easy for slices of data to be taken out of context, or for correlation to be confused with causation.

Instead, the gold standard of education research is a field trial in which similar groups of students are randomly assigned to classes where one uses the curriculum and the other does not.

The Carnegie Web site lists five such trials and says they all show positive results for Cognitive Tutor.

Three of these studies, however, were rejected by the What Works Clearinghouse for flaws in their design; in a fourth, the clearinghouse identified a problem with part of the study — the part that purported to show benefits. One of the rejected studies had found that users of Cognitive Tutor in 10 Miami high schools scored better on Florida state exams than a control group, but the clearinghouse found that the students being compared were not equivalent.

"The entire 'effect' of Cognitive Tutor possibly can be traced to other factors," said Mark Dynarski, a former director of the clearinghouse, "and the way in which the research was carried out does not allow one to know if this is the case."

Dr. Ritter, Carnegie's chief scientist, noted that the clearinghouse's 2010 review was limited to high schools and that a year earlier it found that Cognitive Tutor had "potentially positive effects" in middle school.

The middle school finding rested on one study, out of 14 reviewed. That study is featured prominently on the Carnegie Web site, which omits mention of two others that the Education Department judged to be well designed but showed no benefits.

Dr. Ritter said he had excluded those studies, in Hawaii and Virginia, because the students had not used Cognitive Tutor precisely as the company intended. The researcher who did the Hawaii study, Dennis Newman, said it reflected how Cognitive Tutor was used in the real world.

Dr. Newman is also the author of research guidelines for the Software and Information Industry Association, where Dr. Ritter sits on the education research working group. One of those guidelines states, "An expectation in the scientific community is that research findings are made available regardless of the result."

Karen Cator, a former Apple executive who directs the Office of Educational Technology at the Department of Education, said the clearinghouse reports on software should be "taken with a grain of salt" because they rely on standardized test scores. Those tests, Ms. Cator said, cannot gauge some skills that technology teaches, like collaboration, multimedia and research.

Ms. Cator's office is developing a new framework to measure the educational value of technology, but she advised schools and districts not to wait to invest in software like Cognitive Tutor.

"They know what their students need to know and what they need to be able to do," she said.

Real-Time Assessments

In Augusta, Dr. Allen, the math coordinator, said her district did not have the means to study the effectiveness of Cognitive Tutor formally. But she and her staff saw that low-achieving students who used it were able to join mainstream classes. And teachers appreciated the way the software transmits assessments in real time to Carnegie Learning, then kicks back a report indicating the strengths and weaknesses of each student.

Teachers "just didn't know, skill by skill, the same type of data they are getting now," Dr. Allen said.

On the other hand, when the new state math test was given in March, 27 percent of the district's 11th graders did not pass, which Dr. Allen described as "something that makes us not real excited."

At the June meeting with Carnegie Learning's sales team, Dr. Allen said Cognitive Tutor could be worthwhile if the district, which has recently cut $7 million from its budget and furloughed employees for nine days, could scrape together the financing. "Our negotiations are intense because we don't have any money," she said to laughter around the table.

In Georgia, where the state negotiates prices with publishers, an annual license for Cognitive Tutor software is $32 per student, and the workbook, which must be replaced annually, is $24 — for a total of $336 over six years, a typical lifespan of a math textbook that costs about $120.

Ultimately, Dr. Allen's district did not have the money, so she focused on getting the most out of her staff. "Giving them the right tools and resources certainly helps," she said, "but our teachers are the ones making that difference."

Gregory W. Capelli, co-chief executive of the Apollo Group, which runs the 400,000-student University of Phoenix and bought Carnegie Learning this summer, said his company first ran its own pilot project with the software and also examined independent research.

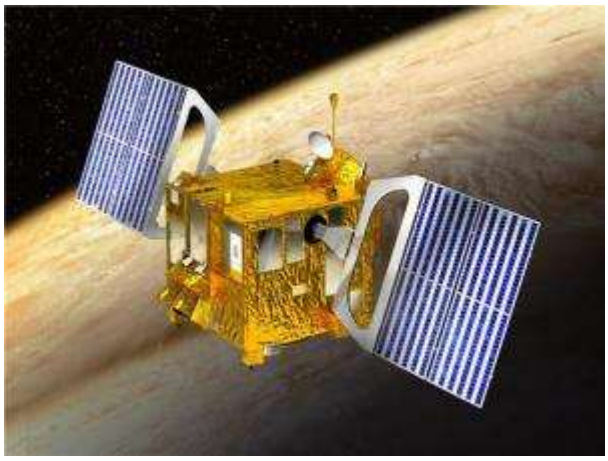
But Mr. Capelli, like others, relied at least in part on personal experience.

"My daughter, who's in eighth grade, used this product," he said.

"She would do very well" in some lessons "and not in others," Mr. Capelli said. "What I liked about it is that once she got it, it would allow her to go on to the next part of the tree."

http://www.nytimes.com/2011/10/09/technology/a-classroom-software-boom-but-mixed-results-despite-the-hype.html?_r=1&hp

Venus Has an Ozone Layer Too, Space Probe Discovers



Artist's rendering of Venus Express. (Credit: ESA - D. Ducros)

ScienceDaily (Oct. 9, 2011) — The European Space Agency's Venus Express spacecraft has discovered an ozone layer high in the atmosphere of Venus. Comparing its properties with those of the equivalent layers on Earth and Mars will help astronomers refine their searches for life on other planets.

The results are being presented at the Joint Meeting of the European Planetary Science Congress and the American Astronomical Society's Division for Planetary Sciences.

Venus Express made the discovery while watching stars seen right at the edge of the planet set through its atmosphere. Its SPICAV instrument analysed the starlight, looking for the characteristic fingerprints of gases in the atmosphere as they absorbed light at specific wavelengths.

The ozone was detectable because it absorbed some of the ultraviolet from the starlight. Ozone is a molecule containing three oxygen atoms. According to computer models, the ozone on Venus is formed when sunlight breaks up carbon dioxide molecules, releasing oxygen atoms.

These atoms are then swept around to the nightside of the planet by winds in the atmosphere: they can then combine to form two-atom oxygen molecules, but also sometimes three-atom ozone molecules.

"This detection gives us an important constraint on understanding the chemistry of Venus' atmosphere," says Franck Montmessin, who led the research.

It may also offer a useful comparison for searching for life on other worlds. Ozone has only previously been detected in the atmospheres of Earth and Mars. On Earth, it is of fundamental importance to life because it absorbs much of the Sun's harmful ultraviolet rays. Not only that, it is thought to have been generated by life itself in the first place.

The build-up of oxygen, and consequently ozone, in Earth's atmosphere began 2.4 billion years ago. Although the exact reasons for it are not entirely understood, microbes excreting oxygen as a waste gas must have played an important role.

Along with plant life, they continue to do so, constantly replenishing Earth's oxygen and ozone. As a result, some astrobiologists have suggested that the simultaneous presence of carbon dioxide, oxygen and ozone in an atmosphere could be used to tell whether there could be life on the planet.

This would allow future telescopes to target planets around other stars and assess their habitability. However, as these new results highlight, the amount of ozone is crucial.

The small amount of ozone in Mars' atmosphere has not been generated by life. There, it is the result of sunlight breaking up carbon dioxide molecules. Venus too, now supports this view of a modest ozone build-up by non-biological means. Its ozone layer sits at an altitude of 100 km, about four times higher in the atmosphere than Earth's and is a hundred to a thousand times less dense.

Theoretical work by astrobiologists suggests that a planet's ozone concentration must be 20%of Earth's value before life should be considered as a cause. These new results support that conclusion because Venus clearly remains below this threshold.

"We can use these new observations to test and refine the scenarios for the detection of life on other worlds," says Dr Montmessin.

Yet, even if there is no life on Venus, the detection of ozone there brings Venus a step closer to Earth and Mars. All three planets have an ozone layer.

"This ozone detection tells us a lot about the circulation and the chemistry of Venus' atmosphere" says Håkan Svedhem, ESA Project Scientist for the Venus Express mission. "Beyond that, it is yet more evidence of the fundamental similarity between the rocky planets, and shows the importance of studying Venus to understand them all."

Story Source:

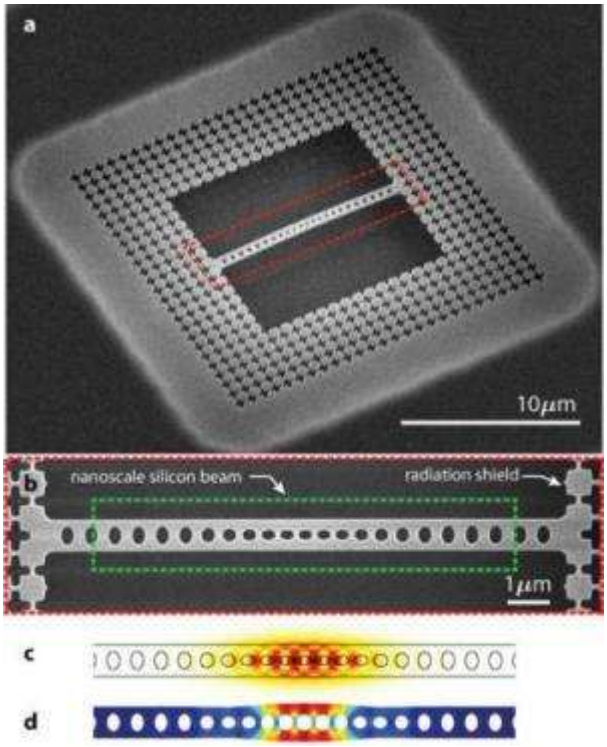
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Europlanet Media Centre**, via AlphaGalileo.

Journal Reference:

1. F. Montmessin, J.-L. Bertaux, F. Lefèvre, E. Marcq, D. Belyaev, J.-C. Gérard, O. Korablev, A. Fedorova, V. Sarago, A.C. Vandaele. **A layer of ozone detected in the nightside upper atmosphere of Venus**. *Icarus*, 2011; 216 (1): 82 DOI: 10.1016/j.icarus.2011.08.010

http://www.sciencedaily.com/releases/2011/10/111006085328.htm

Laser Light Used to Cool Object to Quantum Ground State



A scanning electron microscope image (a) of the nanoscale silicon mechanical resonator used in the laser cooling experiment. The outer "cross" patterning forms the shield while the central beam region, the SEM image of which is shown in (b), forms an optical cavity where laser light is used to cool the mechanical motion of the beam. Numerical simulations of the localized optical field and mechanical breathing motion of the nanobeam are shown in panels (c) and (d), respectively. (Credit: Caltech/Painter, et al.)

ScienceDaily (Oct. 9, 2011) — For the first time, researchers at the California Institute of Technology (Caltech), in collaboration with a team from the University of Vienna, have managed to cool a miniature mechanical object to its lowest possible energy state using laser light. The achievement paves the way for the development of exquisitely sensitive detectors as well as for quantum experiments that scientists have long dreamed of conducting.

"We've taken a solid mechanical system -- one made up of billions of atoms -- and used optical light to put it into a state in which it behaves according to the laws of quantum mechanics. In the past, this has only been achieved with trapped single atoms or ions," says Oskar Painter, professor of applied physics and executive officer for applied physics and materials science at Caltech and the principal investigator on a paper describing the work that appears in the October 6 issue of the journal *Nature*.

As described in the paper, Painter and his colleagues have engineered a nanoscale object -- a tiny mechanical silicon beam -- such that laser light of a carefully selected frequency can enter the system and, once reflected, can carry thermal energy away, cooling the system.

By carefully designing each element of the beam as well as a patterned silicon shield that isolates it from the environment, Painter and colleagues were able to use the laser cooling technique to bring the system down to the quantum ground state, where mechanical vibrations are at an absolute minimum. Such a cold mechanical

object could help detect very small forces or masses, whose presence would normally be masked by the noisy thermal vibrations of the sensor.

"In many ways, the experiment we've done provides a starting point for the really interesting quantum-mechanical experiments one wants to do," Painter says. For example, scientists would like to show that a mechanical system could be coaxed into a quantum superposition -- a bizarre quantum state in which a physical system can exist in more than one position at once. But they need a system at the quantum ground state to begin such experiments.

To reach the ground state, Painter's group had to cool its mechanical beam to a temperature below 100 millikelvin (-273.15°C). That's because the beam is designed to vibrate at gigahertz frequencies (corresponding to a billion cycles per second) -- a range where a large number of phonons are present at room temperature. Phonons are the most basic units of vibration just as the most basic units or packets of light are called photons. All of the phonons in a system have to be removed to cool it to the ground state.

Conventional means of cryogenically cooling to such temperatures exist but require expensive and, in some cases, impractical equipment. There's also the problem of figuring out how to measure such a cold mechanical system. To solve both problems, the Caltech team used a different cooling strategy.

"What we've done is used the photons -- the light field -- to extract phonons from the system," says Jasper Chan, lead author of the new paper and a graduate student in Painter's group. To do so, the researchers drilled tiny holes at precise locations in their mechanical beam so that when they directed laser light of a particular frequency down the length of the beam, the holes acted as mirrors, trapping the light in a cavity and causing it to interact strongly with the mechanical vibrations of the beam.

Because a shift in the frequency of the light is directly related to the thermal motion of the mechanical object, the light -- when it eventually escapes from the cavity -- also carries with it information about the mechanical system, such as the motion and temperature of the beam. Thus, the researchers have created an efficient optical interface to a mechanical element -- or an optomechanical transducer -- that can convert information from the mechanical system into photons of light.

Importantly, since optical light, unlike microwaves or electrons, can be transmitted over large, kilometer-length distances without attenuation, such an optomechanical transducer could be useful for linking different quantum systems -- a microwave system with an optical system, for example. While Painter's system involves an optical interface to a mechanical element, other teams have been developing systems that link a microwave interface to a mechanical element. What if those two mechanical elements were the same? "Then," says Painter, "I could imagine connecting the microwave world to the optical world via this mechanical conduit one photon at a time."

The Caltech team isn't the first to cool a nanomechanical object to the quantum ground state; a group led by former Caltech postdoctoral scholar Andrew Cleland, now at the University of California, Santa Barbara, accomplished this in 2010 using more conventional refrigeration techniques, and, earlier this year, a group from the National Institute of Standards and Technology in Boulder, Colorado, cooled an object to the ground state using microwave radiation. The new work, however, is the first in which a nanomechanical object has been put into the ground state using optical light.

"This is an exciting development because there are so many established techniques for manipulating and measuring the quantum properties of systems using optics," Painter says.

The other cooling techniques used starting temperatures of approximately 20 millikelvin -- more than a factor of 10,000 times cooler than room temperature. Ideally, to simplify designs, scientists would like to initiate

these experiments at room temperature. Using laser cooling, Painter and his colleagues were able to perform their experiment at a much higher temperature -- only about 10 times lower than room temperature.

The work was supported by Caltech's Kavli Nanoscience Institute; the Defense Advanced Research Projects Agency's Microsystems Technology Office through a grant from the Air Force Office of Scientific Research; the European Commission; the European Research Council; and the Austrian Science Fund.

Story Source:

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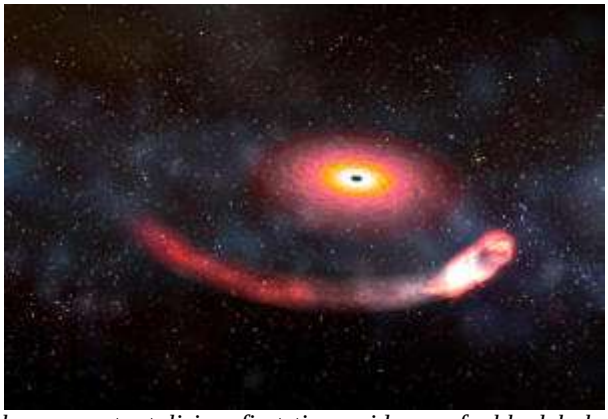
Journal Reference:

1. Jasper Chan, T. P. Mayer Alegre, Amir H. Safavi-Naeini, Jeff T. Hill, Alex Krause, Simon Gröblacher, Markus Aspelmeyer, Oskar Painter. **Laser cooling of a nanomechanical oscillator into its quantum ground state**. *Nature*, 2011; 478 (7367): 89 DOI: 10.1038/nature10461

http://www.sciencedaily.com/releases/2011/10/111005131657.htm

Astrophysics and Extinctions: News About Planet-Threatening Events



Black hole devours a neutron star. Scientists say they have seen tantalizing, first-time evidence of a black hole eating a neutron star-first stretching the neutron star into a crescent, swallowing it, and then gulping up crumbs of the broken star in the minutes and hours that followed. (Credit: Dana Berry/NASA)

ScienceDaily (Oct. 7, 2011) — Space is a violent place. If a star explodes or black holes collide anywhere in our part of the Milky Way, they'd give off colossal blasts of lethal gamma-rays, X-rays and cosmic rays and it's perfectly reasonable to expect Earth to be bathed in them. A new study of such events has yielded some new information about the potential effects of what are called "short-hard" interstellar radiation events.

Several studies in the past have demonstrated how longer high-energy radiation bursts, such as those caused by supernovae, and extreme solar flares can deplete stratospheric ozone, allowing the most powerful and damaging forms of ultraviolet radiation to penetrate to Earth's surface. The probability of an event intense enough to disrupt life on the land or in the oceans becomes large, if considered on geological timescales. So getting a handle on the rates and intensities of such events is important for efforts to connect them to extinctions in the fossil record.

"We find that a kind of gamma ray burst -- a short gamma ray burst -- is probably more significant than a longer gamma ray burst," said astrophysicist Brian Thomas of Washburn University. Improved and accumulated data collected by the SWIFT satellite, which catches gamma ray bursts in action in other galaxies, is providing a better case for the power and threat of the short bursts to life on Earth.

The shorter bursts are really short: less than one second long. They are thought to be caused by the collision of two neutron stars or maybe even colliding black holes. No one is certain which. What is clear is that they are incredibly powerful events.

"The duration is not as important as the amount of radiation," said Thomas. If such a burst were to happen inside the Milky Way, it its effects would be much longer lasting to Earth's surface and oceans.

"What I focused on was the longer term effects," said Thomas. The first effect is to deplete the ozone layer by knocking free oxygen and nitrogen atoms so they can recombine into ozone-destroying nitrous oxides. These long-lived molecules keep destroying ozone until they rain out. "So we see a big impact on the ozone layer."

Those effects are likely to have been devastating for many forms of life on the surface -- including terrestrial and marine plants which are the foundation of the food web.

Based on what is seen among other galaxies, these short bursts, it seems that they occur in any given galaxy at a rate of about once per 100 million years. If that is correct, then it's very likely that Earth has been exposed to such events scores of times over its history. The question is whether they left a calling card in the sky or Earth's geological record.

Astronomical evidence is not likely, said Thomas, because the galaxy spins and mixes pretty thoroughly every million years, so any remnants of blasts are probably long gone from view. There might, however, be evidence in the ground here on Earth, he said. Some researchers are looking at the isotope iron-60, for instance, which has been argued as a possible proxy for radiation events.

If isotopes like iron-60 can reveal the strata of the events, it then becomes a matter of looking for extinction events that correlate and seeing what died and what survived -- which could shed more light on the event itself.

"I work with some paleontologists and we try to look for correlations with extinctions, but they are skeptical," said Thomas. "So if you go and give a talk to paleontologists, they are not quite into it. But to astrophysicists, it seems pretty plausible."

Thomas will be presenting his work on October 9, 2011, at the annual meeting of the Geological Society of America in Minneapolis. This work was supported by the NASA Astrobiology: Exobiology and Evolutionary Biology Program.

Story Source:

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

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Can Cancer Ever Be Ignored?

By SHANNON BROWNLEE and JEANNE LENZER

As chief medical and scientific officer of the American Cancer Society, Otis Webb Brawley — who is also a professor of oncology and epidemiology at Emory University — is the public face of the cancer establishment. He operates in a world of similarly high-achieving, multiple-credentialed, respectable professionals, where insults tend to be delivered, stiletto-style, in scientific language that lay people aren't meant to understand. So it can be more than a little jarring to hear, for example, James Mohler, chairman of the urology department and associate director of the Roswell Park Cancer Institute in Buffalo, say of his friend: "I have known Otis for over 20 years. He doesn't come off as being ignorant or stupid, but when it comes to prostate-cancer screening, he must not be as intelligent as he seems." Or Skip Lockwood, the head of Zero, a prostate-cancer patient advocacy group, charge that Brawley is more concerned about saving men's sex lives than about saving the men themselves.

Brawley has become the target of these attacks because of his blunt and very public skepticism about the routine use of the prostate-specific antigen, or P.S.A., test to screen men for early prostate cancer. "I'm not against prostate-cancer screening," Brawley says. "I'm against lying to men. I'm against exaggerating the evidence to get men to get screened. We should tell people what we know, what we don't know and what we simply believe."

The P.S.A. test, which was approved by the U.S. Food and Drug Administration in 1986, has become an annual ritual for millions of middle-aged men who assume that finding prostate cancer early will prevent death. By 2008, nearly half of men over 50 reported that they were screened in the previous 12 months. Despite the seeming logic of the P.S.A. test, the evidence that it saves lives is far from conclusive, and Brawley is not the only one questioning it. A growing cadre of doctors, epidemiologists, patients and cancer biologists are rethinking its value. And the most recent studies, while not ending the debate, indicate that

routine P.S.A. testing appears not to reduce the number of deaths, and if it does, the benefit is exceedingly modest.

Patients and their doctors are now faced with radically polarized views about the logic of routine testing. On one side are physicians like Mohler, who argue that the test can reduce a man's chances of dying of prostate cancer, plain and simple. This side of the debate is passionate, backed by the persuasive conviction of men who have survived prostate cancer and well financed by the multibillion-dollar industry that has grown up around the testing and treatment of the disease.

The other camp makes a less emotionally satisfying argument: on balance, scientific studies do not support the claim that screening healthy men saves lives. Screening, Brawley and others argue, can lead healthy men into a cascade of further testing and treatments that end up injuring or even killing them. As Richard Ablin, who discovered a prostate-specific antigen, put it in an Op-Ed in The New York Times, using the P.S.A. test to screen for cancer has been "a public health disaster."

So what should a man do when his doctor suggests a routine P.S.A. test? The U.S. Preventive Services Task Force, a panel of independent experts that evaluates the latest scientific evidence on preventive tests and treatments, is charged with making recommendations in just such situations. It already recommends against routine screening for men over 75. According to an internal document, in 2009 the task force conducted an in-depth analysis of data and seemed poised to give routine P.S.A. testing a "D" rating — "D" as in don't do it — for any man of any age. But this was around the time that the task force stated that routine mammography for women ages 40 to 50 was not necessary for every woman. That recommendation caused a public uproar, and Ned Calonge, the task-force chairman at the time, sent the P.S.A. recommendation back for review. One year later, in November 2010, just before midterm elections, the task force was again set to review its recommendation when Calonge canceled the meeting. He says that word leaked out that if the November meeting was held, it could jeopardize the task force's financing. Kenneth Lin, the researcher who led the review, quit his job in protest, and now, nearly two years after its initial finding, it remains uncertain when the task force will release its rating for P.S.A. screening.

Cancer screening is a growing field; existing tests are becoming more sensitive, and new tests are constantly developed. We now have CT scanning for lung cancer, and there is also a blood test marketed by Johnson & Johnson known as a "liquid biopsy," which searches for stray cancer cells in the bloodstream. More testing inevitably brings more treatment, because the urge to correct every cellular anomaly, no matter how small or potentially harmless, is practically irresistible. But if there is one lesson from the P.S.A. test, it is that more information and intervention do not always lead to less suffering.

The popularity of the P.S.A. test as the main weapon against prostate cancer is due in large measure to the earnest and passionate advocacy of William Catalona, a urologist from Northwestern University Feinberg School of Medicine. During his residency training at Johns Hopkins Hospital in the mid-1970s, Catalona set up a clinic for late-stage prostate-cancer patients. Back then, the only tool for finding prostate cancer was a digital rectal exam — actually feeling the prostate through the rectal wall. By the time many tumors could be detected, the cancer was already advanced, and removing the prostate surgically did not offer a reliable cure.

Catalona grew close to many of the men he treated, as well as to their families. "Prostate cancer is a terrible death," he said. "They developed bone fractures, they had a lot of pain, they lost weight. They required heavy doses of narcotics."

Catalona wanted to catch these cancers early, when they might be curable. He noticed that men with more advanced cancers at the time of surgery tended to have the highest P.S.A. levels. Could there be a bright line, a "safe" level of P.S.A. that could distinguish healthy men from those with prostate cancer? After reviewing his own patient records, he decided the cutoff level should be 4 nanograms of P.S.A. per milliliter of blood. He followed up with a study of 1,653 patients. The results, published in 1991 in The New England Journal of

Medicine, showed that P.S.A. testing could detect prostate cancer several years earlier than a digital rectal exam.

The test quickly gained powerful support: Gerald Murphy, who held the position at the American Cancer Society now held by Brawley, pushed the society to endorse the test. In 1996, Gen. H. Norman Schwarzkopf, a prostate-cancer survivor, appeared on the cover of Time magazine over the statement "There's a simple blood test everyone should know about."

By then, doctors were using the test for routine screening. "P.S.A. testing was so easy," says H. Gilbert Welch, a professor of medicine at the Dartmouth Institute (full disclosure: one author of this article is an instructor at Dartmouth). Doctors were predisposed to use the test for several reasons. First and foremost, there was the perception that early detection could save lives. It was also easy to administer. "It was a blood test," Welch says. "You didn't need equipment. . . . You didn't need to put any scopes up any part of the body. Heck, you didn't even need to ask the patient if he wanted it; you could just check off the box on a list of tests, like cholesterol, when you did a blood draw." Today it's common for doctors to order the P.S.A. test and patients to take it without talking about what it might really mean.

At one time, Otis Brawley, too, assumed that routine screening was the best medical practice. Sitting in his living room in an Atlanta suburb, Brawley recounted his transformation from believer to skeptic. In 1988, after medical school at the University of Chicago, Brawley landed a prestigious fellowship at the National Cancer Institute in Bethesda, Md. There he came under the tutelage of Barnett Kramer, an oncologist and epidemiologist who went on to become the associate director of the institute's early detection and community oncology program. Kramer walked Brawley through a short history of screening, beginning with the Pap smear, which has been an unqualified success, significantly cutting cervical-cancer deaths.

But other cancer screening tests had not worked out so well. For example, researchers at the Mayo Lung Project conducted a study between 1971 and 1983 to determine whether frequent chest X-rays could help reduce deaths from lung cancer. Chest X-rays detected lots of suspicious spots and shadows on the lungs and probably led to some cures of early lung cancers, but the study ultimately found no difference in death rates between the patients who were screened and those who were not. Kramer suggested one probable explanation: diagnosing the spots picked up by X-ray often requires surgery, which carries a small but definite risk. Brawley knew that many spots seen on X-rays are simply old scars or minor abnormalities commonly seen in healthy people. With so many innocent blips detected, complications from lung biopsies and other invasive tests, along with treatment complications, could kill enough patients to negate any benefit from early detection.

Prostate cancer is the second-leading cause of cancer death among men, after lung cancer. In 2009, it was diagnosed in approximately 192,000 men. A small number of tumors are very aggressive, but the majority of prostate tumors are not likely to cause death. They grow very slowly, and only a fraction break out of the prostate, seed new tumors in other parts of the body and kill the patient. The current thinking is that about 30 percent of men in their 40s have prostate cancer, 40 percent of men in their 50s and so on, right up to 70 percent of men in their 80s. Yet only 3 percent of all men die from the disease. In other words, far more men die *with* prostate cancer than *from* it, and only a tiny fraction of prostate cancers ever cause symptoms, much less death.

But here is the tricky part: Unless there are symptoms or a finding on a physical exam, doctors generally cannot accurately predict which cancers are destined to be indolent, to sit around for years growing slowly, if at all, and those that will ultimately prove lethal.

In his discussions with Kramer, Brawley saw that these two pieces of information — the fact that a certain number of prostate cancers will never cause harm, and that doctors can't reliably predict which cancers will be dangerous — had powerful and potentially devastating consequences for men. The first implication was

that using the P.S.A. test to screen men who had no symptoms would uncover a huge reservoir of indolent cancers. Most of those cancers that men previously died with — and not from — would now theoretically be detectable. And once detected, the majority of those cancers would be treated.

The most frequent treatment then, as it is now, was the surgical removal of the entire prostate gland. The prostate sits at the base of the penis, wrapped around the urethra, which is the tube that carries urine and semen out of the penis. Trying to separate gland from urethra is a difficult job, and even the best of surgeons can damage the urethra or the bundle of nerves that initiate erections. About half of men who undergo radiation or surgery will have permanent side effects like impotence and incontinence. Up to 1 in 200 men die within 30 days from complications related to the surgery.

“You didn’t have to be brilliant to see that history was repeating itself,” Brawley says. “Doctors were just substituting a blood test for chest X-rays.”

Tim Glynn, a self-described country lawyer from Setauket, N.Y., was 47 in 1997 when he went to his primary-care doctor, troubled by a vague feeling of being down. After his physical exam, Glynn was sent to have his blood drawn. Along with thyroid and cholesterol levels, the doctor ordered a P.S.A. test. A week later, Glynn returned to hear the results. His P.S.A. was elevated. He was told to get a biopsy as soon as possible.

After the biopsy, he walked into a bar in the middle of the afternoon and ordered a martini. A few weeks later, Glynn’s urologist told him the biopsy showed prostate cancer and recommended that he have his prostate removed immediately. Glynn chose to do some homework first.

One of Glynn’s clients happened to be Richard Ablin, the scientist. Ablin told him that not all prostate cancers are alike, and that he could wait; if he developed symptoms, or if his P.S.A. shot up, he could always opt to be treated at that time. (Some doctors recommend “active surveillance,” in which the patient is periodically given P.S.A. testing and biopsies, rather than immediate treatment.) Glynn chose to hold off on surgery.

Kerri Glynn, Tim’s wife of now 39 years, was terrified by her husband’s decision. “I felt as if an ax had fallen,” she says. In her mind it was better to be safe than sorry, and safe meant being treated immediately. “She was a wreck,” Glynn says. “She was scared witless.”

His colleagues were also worried about his decision to forgo treatment. “My business partner was clearly very anxious, and my assistant asked if she should look for a new job,” Glynn recalls. “And there was the fear that if this became public knowledge, there would be clients who wouldn’t want to deal with us because they wouldn’t want to engage a lawyer who was going to be dead the next day. When you see the people around you falling apart, you sort of have to get treated for them, so you can go back to a normal life.”

For many people, not being treated after a diagnosis of cancer is psychologically unbearable. Our view of cancer, says Barnett Kramer, is still shaped by the fact that until relatively recently, cancers were only discovered when they were causing symptoms. Before current treatments were available, such cancers were often fatal. We can now screen for cancers long before they become symptomatic, but it’s still very difficult to imagine that they can safely be left untreated. Brawley says, “I have had patients say, ‘Damn it, I’m an American — you can’t tell me I have cancer and we’re going to watch — you have to treat it.’ ”

Glynn had the surgery. Fourteen years later, he still takes drugs for impotence. It would be more than a year following surgery before he had the energy to play a set of tennis again. “The toll that this took on energy and physicality was like being aged five years,” he says.

One way to look at Glynn's story is as a success. His cancer was removed. His impotence is being managed. But Glynn sees it differently, and so do many other men who have been treated for prostate cancer. Darryl Mitteldorf is the executive director of Malecare, a cancer-patient support group. He says it is not uncommon for men to regret their decision to be tested and treated for prostate cancer. "We have men come in very upset, week after week, telling us what they're not telling their doctors," he says. One-third of men who are given a P.S.A. test were never asked if they wanted it. Of men who are asked, more than half say their doctor failed to mention possible side effects that result from treatment.

Brawley tells the story of a patient who had surgery and then underwent radiation, which left him with severe damage to both his rectum and ureter. "He had every side effect known to man," Brawley says. "He had a bag for urine, a bag for stool, he was a terrible mess, in and out of the hospital with infections." The man died six years after his surgery, from an overwhelming infection. Yet cancer statistics would list such a man as a success story, Brawley says, "because he survived past the five-year mark." Would an untreated prostate cancer have killed him within six years, too? There is simply no way to know.

Many doctors suggest that African-American men and those with a family history should be tested as early as age 40, because they are at increased risk of dying of prostate cancer. But Brawley, who is African-American and has declined P.S.A. screening himself, says this recommendation is based on conjecture, and even for men at higher risk, the test may cause more harm than good. Until the proper studies are done, he asserts, "We just don't know."

The dueling narratives of P.S.A. testing boil down to the way each side frames the potential for harm from the disease compared with the collateral damage from the test and subsequent treatment. Mohler says, "P.S.A., when used intelligently to detect prostate cancer early in men after proper education . . . performs pretty well; it actually performs better than a mammogram." P.S.A. advocates are concerned that statistics play down the value of each life saved. Some also argue that the statistics will validate their view as men are followed beyond 14 years. More important, they worry that if men reject screening, malignant cancers will go undiagnosed.

David Newman, a director of clinical research at Mount Sinai School of Medicine in Manhattan, looks at it differently and offers a metaphor to illustrate the conundrum posed by P.S.A. screening.

"Imagine you are one of 100 men in a room," he says. "Seventeen of you will be diagnosed with prostate cancer, and three are destined to die from it. But nobody knows which ones." Now imagine there is a man wearing a white coat on the other side of the door. In his hand are 17 pills, one of which will save the life of one of the men with prostate cancer. "You'd probably want to invite him into the room to deliver the pill, wouldn't you?" Newman says.

Statistics for the effects of P.S.A. testing are often represented this way — only in terms of possible benefit. But Newman says that to completely convey the P.S.A. screening story, you have to extend the metaphor. After handing out the pills, the man in the white coat randomly shoots one of the 17 men dead. Then he shoots 10 more in the groin, leaving them impotent or incontinent.

Newman pauses. "Now would you open that door?" He argues that the only way to measure any screening test or treatment accurately is to examine overall mortality. That means researchers must look not just at the number of deaths from the disease but also at the number of deaths caused by treatment.

Many experts agree with Newman, and two large studies of P.S.A. screening, published in The New England Journal of Medicine in 2009, came to the same conclusion: There was no difference between the screened and unscreened groups in overall deaths. One trial, conducted in the United States, showed no reduction in prostate-cancer deaths over a period of up to 10 years when men 55 and older were screened. The other, which was carried out in several European countries, showed that screening reduced mortality from prostate

cancer by 20 percent, yet the overall number of deaths in each group was the same. Newman gives one possible reason for this: the benefit of early diagnosis could be offset by complications from diagnostic tests and subsequent treatment.

Each study has been criticized for design and execution issues that might have skewed the results, but the failure to reduce overall mortality reported in the European study is probably no fluke, Newman says. An analysis of six studies of screening involving nearly 400,000 men, published last year in the British medical journal BMJ, found no significant difference in overall mortality when screened men were compared with controls. Philipp Dahm, a professor of urology at the University of Florida College of Medicine and lead investigator for the analysis, says the study shows that P.S.A. screening "does not have a clinically important impact" on overall mortality. Or as Kramer, an author of the U.S. study, crisply puts it, "Men may be trading one cause of death for another."

For Brawley, the greatest tragedy of P.S.A. screening is that it has been a distraction from making greater progress in reducing deaths with the one clear helpful thing: distinguishing between the prostate tumors that really need to come out and those that are better left alone. Instead, new types of P.S.A. screening are being promoted. "We live in a time when our failure to define questions properly has delayed our progress and harmed health," he says. "We keep pursuing son of, son of P.S.A."

As it stands, each man must decide for himself how he wants to play the odds. "Let's put this in perspective," says Welch, whose most recent book is "Overdiagnosed: Making People Sick in the Pursuit of Health." "The European trial says 50 men have to be treated for a cancer that was never going to bother them to reduce one death. Fifty men. That's huge. To me, prostate screening feels like an incredibly bad deal."

Other men, Welch acknowledges, may arrive at a different conclusion, and he is careful to avoid pushing his own patients in one direction or the other. The answer is ultimately personal, he says, and while studies of groups of people can feel unhelpful if you could be the one in the group with cancer, that is all we have to go on.

The solution, in Welch's view, and in that of a growing number of physicians, including Brawley, is to make sure men fully grasp the downstream decisions they may face as a result of screening — the risk of knowing too much. Studies have found that when men are given balanced information about both the cons and pros of P.S.A. testing, they are less likely to opt for screening than men who were merely offered the test. Given this, Brawley asks, how can it be ethical for a doctor not to inform men of the risks — or to fail to even tell a man that the test has been ordered? "If a man understands the risks and benefits and does not want to be screened, that decision should be supported," he says. "But just saying that gets you in trouble."

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http://www.nytimes.com/2011/10/09/magazine/can-cancer-ever-be-ignored.html?ref=magazine

Natural Compound Helps Reverse Diabetes in Mice

Researchers (from left) Shin-ichiro Imai, MD, PhD, Jun Yoshino, MD, PhD, and Kathryn Mills showed that a natural compound, NMN, helps to treat symptoms of diabetes in mice. (Credit: Julia Evangelou Strait)

ScienceDaily (Oct. 7, 2011) — Researchers at Washington University School of Medicine in St. Louis have restored normal blood sugar metabolism in diabetic mice using a compound the body makes naturally. The finding suggests that it may one day be possible for people to take the compound much like a daily vitamin as a way to treat or even prevent type 2 diabetes.

This naturally occurring compound is called nicotinamide mononucleotide, or NMN, and it plays a vital role in how cells use energy.

"After giving NMN, glucose tolerance goes completely back to normal in female diabetic mice," says Shin-ichiro Imai, MD, PhD, associate professor of developmental biology. "In males, we see a milder effect compared to females, but we still see an effect. These are really remarkable results. NMN improves diabetic symptoms, at least in mice."

The research appears online Oct. 4 in *Cell Metabolism*.

Imai says this discovery holds promise for people because the mechanisms that NMN influences are largely the same in mice and humans.

"But whether this mechanism is equally compromised in human patients with type 2 diabetes is something we have to check," Imai says. "We have plans to do this in the very near future."

All cells in the body make NMN in a chain of reactions leading to production of NAD, a vital molecule that harvests energy from nutrients and puts it into a form cells can use. Among other things, NAD activates a protein called SIRT1 that has been shown to promote healthy metabolism throughout the body, from the pancreas to the liver to muscle and fat tissue.

According to the study, aging and eating a high-fat diet reduce production of NMN, slowing the body's production of NAD and leading to abnormal metabolic conditions such as diabetes. NAD cannot be given to the mice directly because of toxic effects. But after administering NMN, levels of NAD rise and the diabetic mice show dramatically improved responses to glucose. In some cases, they return to normal.

"I'm very excited to see these results because the effect of NMN is much bigger than other known compounds or chemicals," says first author Jun Yoshino, MD, PhD, postdoctoral research associate. "Plus, the fact that the body naturally makes NMN is promising for translating these findings into humans."

Imai and his colleagues found that young, healthy mice on a high-fat diet developed diabetes in six months or less. In these mice, they found that NAD levels were reduced. But after administering NMN, levels of NAD increased and the female mice had normal results in glucose tolerance tests -- a measure of how well the body moves glucose from the blood to the organs and tissues for use. Glucose tolerance was also improved after male diabetic mice received NMN but did not quite return to normal. The researchers are interested in learning more about these differences between male and female mice.

"We don't have a clear answer, but we are speculating that sex hormones, such as estrogen, may be important downstream for NAD synthesis," Yoshino says.

In older mice, they observed that about 15 percent of healthy males fed a normal diet developed diabetes.

"When we injected these older diabetic mice with NMN, they had improved glucose tolerance, even after one injection," says Kathryn F. Mills, research lab supervisor and an equally contributing first author of the study. "We also injected older healthy mice and found that they weren't adversely affected. It's good to know that even if the mice are not diabetic, giving NMN is not going to hurt them."

Imai says few studies have examined normal mice that naturally develop diabetes as a simple result of aging because the experiments take so long. In an interesting twist, few elderly female mice developed diabetes at all. But after switching to a high fat diet, older female mice quickly developed severe diabetes.

"Again, when we injected these females with NMN, we came up with a completely normal glucose tolerance curve," Mills says. "We can also see that the NMN has completely reversed and normalized the levels of cholesterol, triglycerides and free fatty acids."

Though the mice received NMN by injection in this study, Imai's group is now conducting a long-term study of diabetic mice that get NMN dissolved in their drinking water. Imai calls this work a first step toward a possible "nutriceutical" that people could take almost like a vitamin to treat or even prevent type 2 diabetes.

"Once we can get a grade of NMN that humans can take, we would really like to launch a pilot human study," Imai says.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Washington University School of Medicine**. The original article was written by Julia Evangelou Strait.

Journal Reference:

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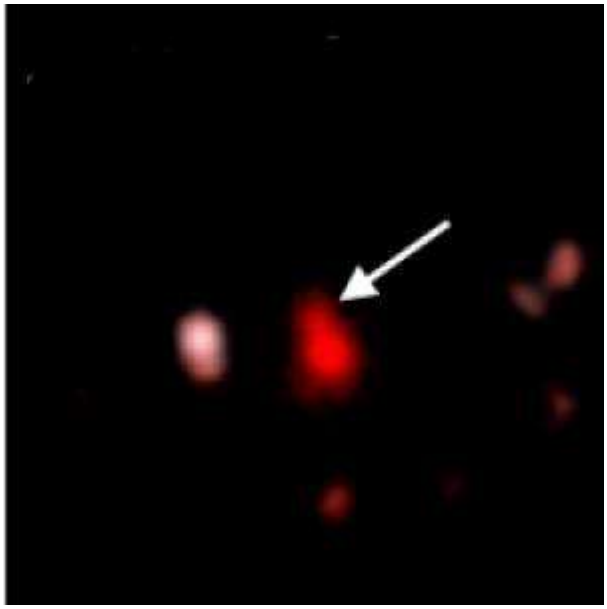
http://www.sciencedaily.com/releases/2011/10/111004123602.htm

Ancient Supernovas Discovered: 10-Billion-Year-Old Exploding Stars Were a Source of Earth's Iron, Researchers Say



One of ten supernovas in the Subaru Deep Field, which exploded 10 billion years ago. (Credit: Tel Aviv University.)

ScienceDaily (Oct. 7, 2011) — Supernovas -- stars in the process of exploding -- open a window onto the history of the elements of Earth's periodic table as well as the history of the universe. All of those heavier than oxygen were formed in nuclear reactions that occurred during these explosions.

The most ancient explosions, far enough away that their light is reaching us only now, can be difficult to spot. A project spearheaded by Tel Aviv University researchers has uncovered a record-breaking number of supernovas in the Subaru Deep Field, a patch of sky the size of a full moon. Out of the 150 supernovas observed, 12 were among the most distant and ancient ever seen.

The discovery sharpens our understanding of the nature of supernovas and their role in element formation, say study leaders Prof. Dan Maoz, Dr. Dovi Poznanski and Or Graur of TAU's Department of Astrophysics at the Raymond and Beverly Sackler School of Physics and Astronomy. These "thermonuclear" supernovas in particular are a major source of iron in the universe.

The research, which appears in the *Monthly Notices of the Royal Astronomical Society* this month, was done in collaboration with teams from a number of Japanese and American institutions, including the University of Tokyo, Kyoto University, the University of California Berkeley, and Lawrence Berkeley National Laboratory.

A key element of the universe

Supernovas are nature's "element factories." During these explosions, elements are both formed and flung into interstellar space, where they serve as raw materials for new generations of stars and planets. Closer to home, says Prof. Maoz, "these elements are the atoms that form the ground we stand on, our bodies, and the iron in the blood that flows through our veins." By tracking the frequency and types of supernova explosions back through cosmic time, astronomers can reconstruct the universe's history of element creation.

In order to observe the 150,000 galaxies of the Subaru Deep Field, the team used the Japanese Subaru Telescope in Hawaii, on the 14,000-foot summit of the extinct Mauna Kea volcano. The telescope's light-collecting power, sharp images, and wide field of view allowed the researchers to overcome the challenge of viewing such distant supernovas.

By "staring" with the telescope at the Subaru Deep Field, the faint light of the most distant galaxies and supernovas accumulated over several nights at a time, forming a long and deep exposure of the field. Over the course of observations, the team "caught" the supernovas in the act of exploding, identifying 150 supernovas in all.

Sourcing man's life-blood

According to the team's analysis, thermonuclear type supernovas, also called Type-la, were exploding about five times more frequently 10 billion years ago than they are today. These supernovas are a major source of iron in the universe, the main component of Earth's core and an essential ingredient of the blood in our bodies.

Scientists have long been aware of the "universal expansion," the fact that galaxies are receding from one another. Observations using Type-Ia supernovas as beacons have shown that the expansion is accelerating, apparently under the influence of a mysterious "dark energy" -- the 2011 Nobel Prize in Physics will be awarded to three astronomers for this work. However, the nature of the supernovas themselves is poorly understood. This study improves our understanding by revealing the range of the ages of the stars that explode as Type-Ia supernovas. Eventually, this will enhance their usefulness for studying dark energy and the universal expansion, the researchers explain.

Story Source:

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

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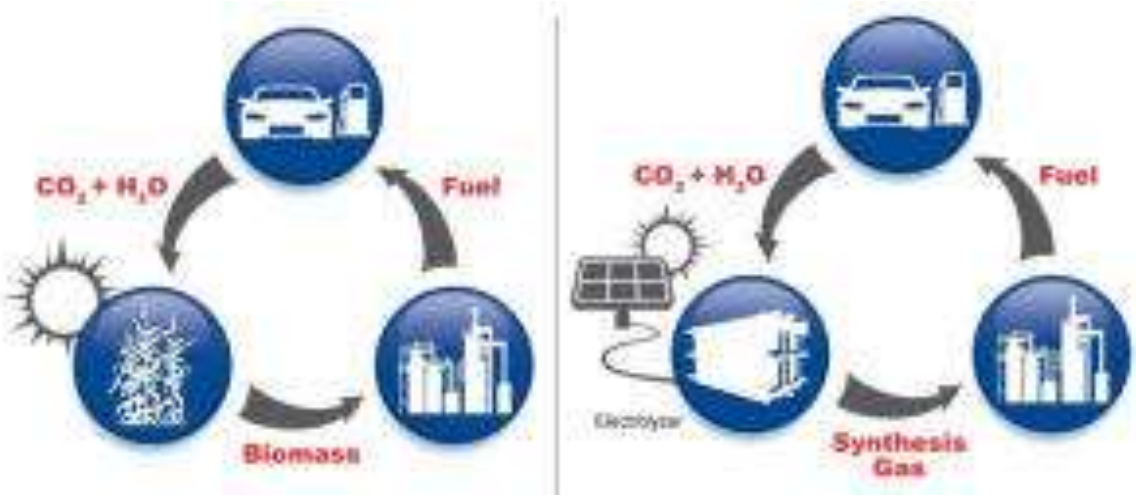
http://www.sciencedaily.com/releases/2011/10/111005090434.htm

Ionic Liquid Catalyst Helps Turn Emissions Into Fuel



Biofuel production (left) compared to fuel produced via artificial synthesis. Crops takes in CO2, water and sunlight to create biomass, which then is transferred to a refinery to create fuel. In the artificial photosynthesis route, a solar collector or windmill collects energy that powers an electrolyzer, which converts CO2 to a synthesis gas that is piped to a refinery to create fuel. (Credit: Graphic by Dioxide Materials)

ScienceDaily (Oct. 7, 2011) — An Illinois research team has succeeded in overcoming one major obstacle to a promising technology that simultaneously reduces atmospheric carbon dioxide and produces fuel.

University of Illinois chemical and biological engineering professor Paul Kenis and his research group joined forces with researchers at Dioxide Materials, a startup company, to produce a catalyst that improves artificial photosynthesis. The company, in the university Research Park, was founded by retired chemical engineering professor Richard Masel. The team reported their results in the journal Science.

Artificial photosynthesis is the process of converting carbon dioxide gas into useful carbon-based chemicals, most notably fuel or other compounds usually derived from petroleum, as an alternative to extracting them from biomass.

In plants, photosynthesis uses solar energy to convert carbon dioxide (CO_2) and water to sugars and other hydrocarbons. Biofuels are refined from sugars extracted from crops such as corn. However, in artificial photosynthesis, an electrochemical cell uses energy from a solar collector or a wind turbine to convert CO_2 to simple carbon fuels such as formic acid or methanol, which are further refined to make ethanol and other fuels.

"The key advantage is that there is no competition with the food supply," said Masel, a co-principal investigator of the paper and CEO of Dioxide Materials, "and it is a lot cheaper to transmit electricity than it is to ship biomass to a refinery."

However, one big hurdle has kept artificial photosynthesis from vaulting into the mainstream: The first step to making fuel, turning carbon dioxide into carbon monoxide, is too energy intensive. It requires so much electricity to drive this first reaction that more energy is used to produce the fuel than can be stored in the fuel.

The Illinois group used a novel approach involving an ionic liquid to catalyze the reaction, greatly reducing the energy required to drive the process. The ionic liquids stabilize the intermediates in the reaction so that less electricity is needed to complete the conversion.

The researchers used an electrochemical cell as a flow reactor, separating the gaseous CO_2 input and oxygen output from the liquid electrolyte catalyst with gas-diffusion electrodes. The cell design allowed the researchers to fine-tune the composition of the electrolyte stream to improve reaction kinetics, including adding ionic liquids as a co-catalyst.

"It lowers the overpotential for CO_2 reduction tremendously," said Kenis, who is also a professor of mechanical science and engineering and affiliated with the Beckman Institute for Advanced Science and Technology. "Therefore, a much lower potential has to be applied. Applying a much lower potential corresponds to consuming less energy to drive the process."

Next, the researchers hope to tackle the problem of throughput. To make their technology useful for commercial applications, they need to speed up the reaction and maximize conversion.

"More work is needed, but this research brings us a significant step closer to reducing our dependence on fossil fuels while simultaneously reducing CO_2 emissions that are linked to unwanted climate change," Kenis said.

Graduate students Brian Rosen, Michael Thorson, Wei Zhu and Devin Whipple and postdoctoral researcher Amin Salehi-Khojin were co-authors of the paper. The U.S. Department of Energy supported this work.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Illinois at Urbana-Champaign**.

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http://www.sciencedaily.com/releases/2011/10/111006162537.htm

Putting Museumgoers on the Fast Track

By CAROL VOGEL

If all goes as planned, the New Museum's five-year-old building on the Bowery will become something of an amusement park beginning Oct. 26, with visitors hurtling through a giant plastic tube from the fourth floor to the second.

It's not the first time that the German artist Carsten Höller has installed a slide in a museum. He has put slides in art capitals like Berlin, Milan and São Paolo, Brazil. In 2006 the Tate Modern's cavernous Turbine Hall in London became a playground overrun with visitors shooting through five tubular slides like so many packages going through pneumatic tubes. For safety baseball helmets and elbow pads were issued by the Tate staff, but some who took the plunge reported they got bumps and bruises anyway.

Undaunted, Mr. Höller is hoping to take New York museumgoers on a ride too. Building starts next week on the slide, which will be 40 feet high, 102 feet long and fashioned out of transparent plastic.

"Installing it involves removing portions of the floor and ceilings," said Lisa Phillips, the New Museum's director. "And since the slide can't go straight through the center of the building because of structural issues, it will take twists and turns."

Well aware of the potential dangers, Ms. Phillips said she had "had the benefit of talking to all 11 venues" that have had slides before. And Mr. Höller has re-engineered this particular slide so riders will have a soft landing.

The museum will offer helmets and elbow pads. There will also be lockers for visitors to park their belongings when they slide.

The work is Mr. Höller's comment on utopian forms of transportation. "It's a visionary way to connect buildings and spaces," Ms. Phillips said.

STIEGLITZ AT THE MET

The two things most people already know about Alfred Stieglitz: He was a legendary photographer, and he was married to Georgia O'Keeffe. But Stieglitz also owned several Manhattan art galleries where, from 1905 to 1946, he championed important artists of the day: American painters like Charles Demuth, Arthur Dove and Marsden Hartley, along with European masters like Matisse and Picasso.

Stieglitz not only bought and sold their work but collected it too. In 1949, three years after his death, O'Keeffe gave the Metropolitan Museum of Art a treasure trove from his collection — 39 paintings, 5 sculptures, 214 drawings and watercolors and 170 prints — because, she said, he was "so definitely a New Yorker."

Were news of this gift to have reached Stieglitz, he might have screamed from the grave. Known for being anti-art-establishment, he had a love-hate relationship with both the Museum of Modern Art, whose director, Alfred H. Barr Jr., he felt was more interested in European than American art, and with the Met, whose galleries he once said had "an atmosphere breathing of a cemetery dedicated to the dead rich."

But "Stieglitz and His Artists: Matisse to O'Keeffe," a large exhibition that opens at the Met on Thursday, might have changed his thinking. So might a companion exhibition of his personal photography collection.

The main exhibition, 15 years in the making, will be the first since 1949 to show the Met's vast Stieglitz holdings together. Mounted in a second-floor exhibition space generally reserved for large loan shows, it will fill 14 galleries and include some 200 works.

"Still, I am only able to put up about half of what was received," said Lisa M. Messinger, an associate curator in the Met's department of 19th-century, modern and contemporary art, who organized the show. Although the 30-odd paintings in the exhibition will probably be familiar to visitors because they are usually on view at the museum, they have never been seen in the context of Stieglitz's collection, which includes scores of watercolors and drawings rarely seen because of their delicacy.

As a photographer Stieglitz was particularly enamored of works on paper, Ms. Messinger said. Standouts in the show will be Picasso's "Standing Female Nude," from 1910, and a group of early drawings by O'Keeffe that Stieglitz acquired before he met her. The show will also include caricatures of Stieglitz by the avant-garde Mexican artist Marius de Zayas. One shows him as a camera.

As often happens when curators immerse themselves in a subject, weird and arcane facts emerged. Ms. Messinger was surprised to learn that although Stieglitz exhibited Severini, he really never liked his work or Futurism in general. Writing to O'Keeffe on the eve of a show he was organizing, Stieglitz confessed: "Today the Severinis came from France ... The color is acid & gives me the creeps. — The work is thin."

Ms. Messinger said: "The assumption has always been that because Stieglitz showed Severini, he liked his work. But it turns out not so much."

A BROADWAY ZOO

A zoo is coming to Broadway. From Oct. 21 through April cast bronze sheep, ostriches, crows, hens and bulls, among other animals, will take over Broadway Malls, the landscaped medians from 60th Street to 168th Street.

The exhibition is the work of Peter Woytuk, a sculptor who spends most of his time in Thailand.

A life-size "Elephant Pair," installed at Columbus Circle, and three 2,500-pound seated bulls, at Mitchel Square at 168th Street, will bookend the show.

This is Mr. Woytuk's first public art exhibition in New York. "We've custom-made a few pieces," he said in a telephone interview.

Describing his work, Mr. Woytuk said: "They are animal forms, but that's not what it's really about. They are anthropomorphic. I'm a formalist. I'm interested in shapes, textures and colors."

The show is being organized by the nonprofit Broadway Mall Association in partnership with the New York City Departments of Transportation and Parks and Recreation.

At each location a sign will include a telephone number so people can take a cellphone tour — in English or Spanish — narrated by the artist.

http://www.nytimes.com/2011/10/07/arts/design/carsten-holler-is-installing-a-slide-at-new-museum.html?ref=design

Crab Pulsar Beams Most Energetic Gamma Rays Ever Detected from a Pulsar

One of the most studied objects in the sky, the Crab Nebula is powered by a pulsar. This composite image of the Crab Nebula uses data from the Chandra X-ray Observatory (x-ray image in blue), Hubble Space Telescope (optical image in red and yellow), and Spitzer Space Telescope (infrared image in purple). (Credit: X-ray: NASA/CXC/SAO/F.Seward; Optical: NASA/ESA/ASU/J.Hester & A.Loll; Infrared: NASA/JPL-Caltech/Univ. Minn./R.Gehrz)

ScienceDaily (Oct. 7, 2011) — Astrophysicists have detected pulsed gamma-ray emission from the Crab pulsar at energies far beyond what current theoretical models of pulsars can explain.

With energies exceeding 100 billion electron-volts (100 GeV), the surprising gamma-ray pulses were detected by the VERITAS telescope array at the Whipple Observatory in Arizona and reported by an international team of scientists in a paper in the October 7 issue of *Science*. Corresponding author Nepomuk Otte, a postdoctoral researcher at the University of California, Santa Cruz, said that some researchers had told him he was crazy to even look for pulsar emission in this energy realm.

"It turns out that being persistent and stubborn helps," Otte said. "These results put new constraints on the mechanism for how the gamma-ray emission is generated."

Otte, Andrew McCann of McGill University in Montreal, and Martin Schroedter of the Smithsonian Astrophysical Observatory performed most of the analytic work for the study, which involved nearly 100 scientists in the VERITAS collaboration. VERITAS spokesperson Rene Ong, professor of physics and astronomy at UCLA, credited Otte as the leading advocate for using the powerful gamma-ray observatory to study the Crab pulsar.

"To me it's a real triumph of the experimental approach, not going along with the flow and making assumptions, but just observing to see what there is. And lo and behold, we see something different than what everybody expected," Ong said.

The Crab pulsar is a rapidly spinning neutron star, the collapsed core of a massive star that exploded in a spectacular supernova in the year 1054, leaving behind the brilliant Crab Nebula, with the pulsar at its heart. It is one of the most intensively studied objects in the sky. Rotating about 30 times a second, the pulsar has an intense, co-rotating magnetic field from which it emits beams of radiation. The beams sweep around like a lighthouse beacon because they are not aligned with the star's rotation axis. So although the beams are steady, they are detected on Earth as rapid pulses of radiation.

Scientists have long agreed on a general picture of what causes pulsar emission. Electromagnetic forces created by the star's rapidly rotating magnetic field accelerate charged particles to near the speed of light, producing radiation over a broad spectrum. But the details remain a mystery.

"After many years of observations and results from the Crab, we thought we had an understanding of how it worked, and the models predicted an exponential decay of the emission spectrum above around 10 GeV. So it came as a real surprise when we found pulsed gamma-ray emission at energies above 100 GeV," said coauthor David Williams, adjunct professor of physics at UC Santa Cruz and a member of the VERITAS collaboration.

Prior to these new results, a phenomenon known as curvature radiation was the leading explanation for the Crab's pulsed gamma-ray emission. Curvature radiation is produced when a high-energy charged particle moves along a curved magnetic field. But according to Otte, this mechanism cannot account for gamma rays with energies above 100 GeV.

"The conventional wisdom was that the dominant mechanism is curvature radiation. But the VERITAS results have shown that there must be a different mechanism at work," Otte said. "Curvature radiation can explain the lower-energy emission, but we really don't know what causes the very high-energy emission."

One possible scenario may be a process known as inverse Compton scattering, which involves energy transfer from charged particles to photons. "That seems to be a more likely scenario now, but we still don't know the details of how this works," Otte said. It is also not clear whether one mechanism dominates at all gamma-ray energies, or if curvature radiation dominates at lower energies and something like inverse Compton scattering dominates at higher energies.

According to Ong, researchers will need to characterize the very high-energy gamma-ray emission in much greater detail in order to gain more insight into the mechanisms behind it. "We need to take more measurements and get the exact shape of the spectrum at these very high energies," he said.

The VERITAS observations open up a new avenue for testing Einstein's theory of special relativity, which says that the speed of light is a universal constant. One of the predictions of a quantum theory of gravity, which emerges from efforts to reconcile quantum mechanics and general relativity, is that the speed of light actually may have a small dependence on the energy of the photon. This would be a violation of "Lorentz invariance," which is at the core of special relativity, but it might be detectable in the VERITAS data, Otte

said. Photons with a range of energies are emitted by the pulsar at the same time. If photons with different energies travel at different speeds, the effect would manifest itself as a slight shift in the position of the pulses at different energies.

Story Source:

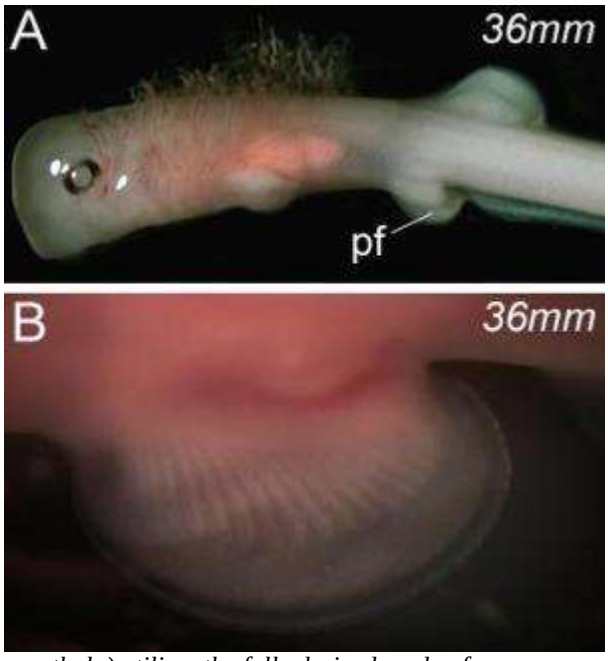
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of California - Santa Cruz**. The original article was written by Tim Stephens.

Journal Reference:

1. The VERITAS Collaboration et al. **Detection of Pulsed Gamma Rays Above 100 GeV from the Crab Pulsar**. *Science*, October 7, 2011 DOI: 10.1126/science.1208192

http://www.sciencedaily.com/releases/2011/10/111006141358.htm

Lungfish Provides Insight to Life On Land: 'Humans Are Just Modified Fish'



Pectoral fin muscle formation in paddlefish (Polyodon spathula) utilises the fully derived mode of appendicular muscle formation and is not associated with an epithelial extension. (Credit: Cole et al., PLoS Biology, DOI: 10.1371/journal.pbio.1001168)

ScienceDaily (Oct. 7, 2011) — A study into the muscle development of several different fish has given insights into the genetic leap that set the scene for the evolution of hind legs in terrestrial animals. This innovation gave rise to the tetrapods -- four-legged creatures, and our distant ancestors -- that made the first small steps on land some 400 million years ago.

A team of Australian scientists led by Professor Peter Currie, of the Australian Regenerative Medicine Institute at Monash University, and Dr Nicolas Cole, of the University of Sydney, report their results October 4 in online, open access journal *PLoS Biology.*

Scientists have long known that ancient lungfish species are the ancestors of the tetrapods. These fish could survive on land, breathing air and using their pelvic fins to propel themselves. Australia is home to three species of the few remaining lungfish -- two marine species and one inhabiting Queensland's Mary River basin.

There are big gaps in our knowledge, however. Most conclusions have previously been drawn from fossil skeletons, but the muscles critical to locomotion cannot be preserved in the fossil record. The team used fish living today to trace the evolution of pelvic fin muscles to find out how the load-bearing hind limbs of the tetrapods evolved. They compared embryos of the descendants of species representing key turning points in vertebrate evolution to see if there were differences in pelvic fin muscle formation. They studied "primitive" cartilaginous fish -- Australia's bamboo shark and its cousin, the elephant shark -- as well as three bony fishes -- the Australian lungfish, the zebrafish and the American paddlefish. The bony fish and in particular the lungfish are the closest living relative of the tetrapods' most recent common ancestor with fish.

"We examined the way the different fish species generated the muscles of their pelvic fins, which are the evolutionary forerunners of the hind limbs," said Professor Currie, a developmental biologist. Currie and his

team genetically engineered the fish to trace the migration of precursor muscle cells in early developmental stages as the animal's body took shape. These cells in the engineered fish were made to emit a red or green light, allowing the team to track the development of specific muscle groups. They found that the bony fish had a different mechanism of pelvic fin muscle formation from that of the cartilaginous fish, a mechanism that was a stepping stone to the evolution of tetrapod physiology.

"Humans are just modified fish," said Professor Currie. "The genome of fish is not vastly different from our own. We have shown that the mechanism of pelvic muscle formation in bony fish is transitional between that in sharks and in our tetrapod ancestors."

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. Nicholas J. Cole, Thomas E. Hall, Emily K. Don, Silke Berger, Catherine A. Boisvert, Christine Neyt, Rolf Ericsson, Jean Joss, David B. Gurevich, Peter D. Currie. **Development and Evolution of the Muscles of the Pelvic Fin**. *PLoS Biology*, 2011; 9 (10): e1001168 DOI: 10.1371/journal.pbio.1001168

http://www.sciencedaily.com/releases/2011/10/111004180106.htm

Is Chivalry the Norm for Insects?

This image shows a female field cricket at the entrance of her burrow with the remains of her former partner after he was predated. (Credit: University of Exeter)

ScienceDaily (Oct. 7, 2011) — The long-standing consensus of why insects stick together after mating has been turned on its head by scientists from the University of Exeter. Published October 6 in *Current Biology*, their study shows that, contrary to previous thinking, females benefit from this arrangement just as much as males.

Instead of dominating their female partners through bullying and aggressive behaviour, males were revealed to be protective, even laying their lives on the line when their mates faced danger.

Previously, scientists assumed that male insects stay close to females after mating to stop them from taking other partners. Female insects have multiple mates and the last mate is most likely to fertilise her eggs. Therefore, by preventing females from taking other mates a male is most likely to father her offspring.

To gain insight into the lives of wild field crickets, the research team used digital video technology, tagging and DNA fingerprinting. They analysed over 200,000 hours of infra-red video footage, taken over two entire breeding seasons, to get a detailed picture of the daily dramas that occur in the insect world.

The researchers found no evidence of males being aggressive towards their mates or hindering a female's movements to or from their burrow. They also discovered that a male will risk his own life to protect a female by allowing her to scamper into their burrow before him when escaping from predators such as birds.

Dr Rolando Rodríguez-Muñozof the University of Exeter said: "Relationships between crickets are rather different from what we'd all assumed. Rather than being bullied by their mates, it seems that females are in fact being protected. We could even describe males as 'chivalrous'.

"Males and females on their own have similar predation rates, but when they are in pairs, males are killed much more frequently and females always survive to predator attacks.

"It's not completely altruistic though -- males are still benefiting. Even if a male is killed, the surviving female is carrying his sperm and ensuring that his DNA lives on."

The team used 96 cameras and microphones to monitor a population of Gryllus campestris crickets in Northern Spain over three entire springs. Super-glued to the back of every cricket was a tiny numbered placard, just big enough for the camera to read. Additionally, a tiny piece of leg tissue less than one

millimeter across was used to create a DNA fingerprint of each individual. The visible tags allowed the researchers to analyse their lives and behaviour, including mating partners, how long particular males and females spent together, the time that each male spent singing to attract females and the fights that occur when a male approaches a burrow occupied by another male.

Professor Tom Tregenza of the University of Exeter said: "Males were protective of their partners, but very aggressive with potential competitors. Males cohabiting with a female won more fights against approaching rival males than when they were on their own.

"The footage we filmed and spent months analysing has given us a rare glimpse into how natural selection really happens in the wild. Although our study focused on one population, it is likely that our findings are applicable to other species across the insect world and could even have relevance for other animals. Perhaps females aren't getting pushed around quite as much as we thought they were."

This study was funded by the Natural Environment Research Council and the Leverhulme Trust.

Story Source:

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

Journal Reference:

1. Rolando Rodríguez-Muñoz, Amanda Bretman, Tom Tregenza. **Guarding Males Protect Females from Predation in a Wild Insect**. *Current Biology*, 06 October 2011 DOI: 10.1016/j.cub.2011.08.053

http://www.sciencedaily.com/releases/2011/10/111006125406.htm

Lines That Kept Moving and Knew No Boundaries

By ROBERTA SMITH

Maybe every museum, regardless of focus, should know the box-office thrill of staging a Picasso exhibition. In 2006 the Whitney Museum — of American Art, mind you — pulled it off with "Picasso and American Art," a somewhat flawed effort that examined his influence on a host of major and minor American artists.

Now the Frick Collection has edged into the field. Its holdings do not extend much beyond the middle of the 19th century, but let's not quibble. "Picasso's Drawings, 1890-1921: Reinventing Tradition" is a model of Frick-like reserve, which may be something of a blessing where Picasso is concerned.

Remarkably free of photographs of the artist and his penetrating gaze, or references to his love life, it follows Picasso over three decades from tentative schoolboy to dominant modernist. The greatness of its 61 drawings tends to be exceeded only by a stylistic diversity that may be unparalleled in the history of art and seems implicitly post-Modern. After a small but fascinating cluster of juvenilia the show covers Picasso's Rose and Blue periods, the monumental climb to Cubism and Cubist collage, and the return to neo-Classical figuration, almost always with freshly unfamiliar works.

This is the first sizable show of Picasso drawings in New York in more than 20 years. It has been organized by Susan Grace Galassi, the Frick's senior curator, and Marilyn McCully, an independent art historian and Picasso specialist; they collaborated with Andrew Robison, senior curator of prints and drawings at the National Gallery in Washington, where the exhibition will open in late January.

The show starts with what may be the first drawing Picasso signed and dated (in 1890), when he was 8 or 9. With considerable, even surprising awkwardness, this work depicts a small bronze statue of Hercules that was displayed in a hallway in his family's home in Málaga in southern Spain; the pencil line scuds cautiously along the statue's silhouette like a small boat hugging the shore, determined to reach home. Over the next few drawings Picasso improves with startling speed, making good on his natural gifts with palpable determination, but also, it would seem, benefiting from the guidance of his less talented father, José Ruiz Blasco, a painter who encouraged his son's artistry in every way he could.

A small bullfight scene made only two years after the Hercules is alive with caricatural zest and a growing command of bodies in motion. Even more telling, in the Oedipal sense, is that Picasso, turning the page around, filled the top with finely realistic renderings of six pigeons, or rock doves, the favored subject of his father, who was known as El Palomero (the Pigeon Fancier). Next comes an exacting, nearly photographic portrait from 1896 of the tall, fair and aristocratic Ruiz himself. (Picasso resembled him not at all, taking after his short, dark, energetic mother.) This is followed by two large, accomplished figure studies — one from a cast, one from a male model — that mark the end of the artist's academic training. By the time he was 18 he was working on his own in Barcelona and in a few years would settle in Paris.

Incessant, restless, often contradictory progress is the name of the game here. Exploring materials, the human face and body, and landscapes or still lifes, Picasso establishes one stylistic or formal promontory after another. Then he jumps, landing somewhere that neither he nor drawing has quite been before. He doesn't seem so much to reinvent tradition, in the words of the show's title, as to simply explode it, without ever losing track of the constituent pieces, which he combines and recombines in stunning ways. He does odd things with his mediums, for example, applying watercolor and gouache with a dry brush in thin, scratchy lines, as in the early Cubist "Still Life With Chocolate Pot," creating an odd tactility that infuses his forms with light.

Picasso's innovations in drawing was not entirely a matter of talent and drive. As Ms. Galassi recounts in her catalog essay, drawings of all kinds were increasingly visible in Paris in the first years of the century. Large survey exhibitions of drawings were in vogue. The Louvre was displaying some 2,500 sheets that stretched from the old masters to the late 19th century. There were also big monographic shows, for example an Ingres retrospective laden with drawings, the fluency and control of which awed both Picasso and Matisse. This is of course in addition to the more familiar Picasso influences, like the art of Paul Cézanne and Paul Gauguin and Iberian and African sculpture, all of which are also at work here.

In other words, Picasso had a lot to look at both in terms of art in general and drawing in particular in early-20th-century Paris. As this show repeatedly indicates, he looked very carefully, with a discriminating voraciousness that many of today's often overly cerebral artists could learn from. A spare ink study for "La Vie," his Blue Period painting, portrays the artist and his mistress Fernande Olivier as wan, otherworldly nudes; according to Ms. Galassi, Picasso was responding to the newly visible works of the so-called primitives of the French and Italian Renaissance. The pair might almost be Adam and Eve, especially since the drawing contains a second image — supposedly a painting on an easel — of a naked couple in an anguished huddle, as if just expelled from the Garden of Eden.

The fragility of the figures in this drawing is immediately countered by its neighbor, a pencil rendering of a thick-limbed, dark-haired nude that pays homage to one of Gauguin's Tahitian odalisques. (It is even signed Paul Picasso.) And this implicitly sculptural figure is but a precursor to the monumental women that emerged in the wake of Picasso's exposure to the ancient Iberian sculpture of Spain, starting in the summer of 1906. The sturdy yet pensive amazons of "Seated Nude and Standing Nude" from the Philadelphia Museum of Art is especially grand; their blunt forms are softened by shaded charcoal that becomes more refined as it moves from background to body to face.

The influence of African sculpture is felt in the angular, animated figure of "Yellow Nude," a study for the epochal 1907 masterpiece "Desmoiselles d'Avignon." The eroticism that flows throughout Picasso's figure drawings acquires a slouchy, thrust-pelvis immediacy here, even as the figure becomes planar and more abstract. The exhibition gives a good account of the ever finer fracturing that leads to Cubism, culminating in three nearly abstract ink drawings of standing nudes that are notable for their very different structures, figurative hints and flurries of marks and textures.

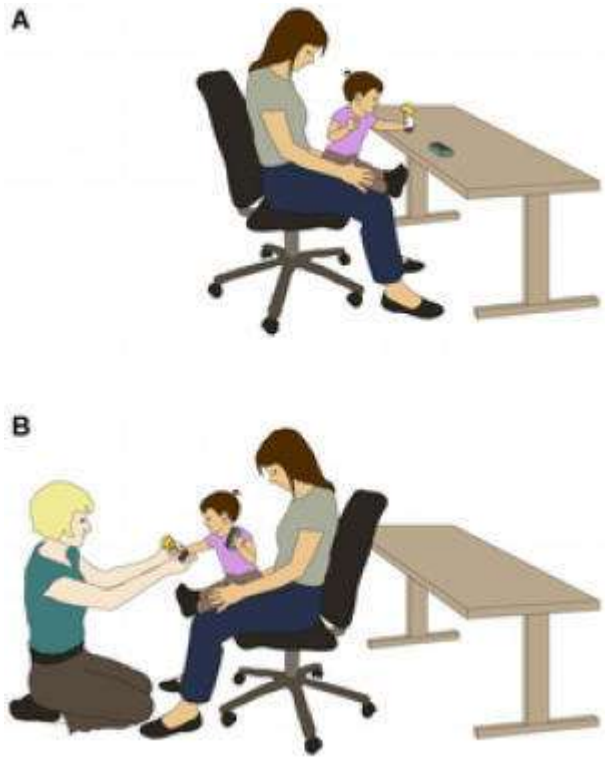
Shortly thereafter Picasso's awe for Ingres comes more and more into play, helped along by Cézanne. A stylish, meticulous realism begins to insinuate itself, negotiating various truces with abstraction, often through

the drawing process. Awe is tinged with humor in Picasso's wonderful portrait of the composer Igor Stravinsky, from 1917, in which thin and thinner lines, partly erased, give Stravinsky a supremely aloof, catlike stillness.

The balance shifts in humor's favor in the elegantly satiric "Two Ballet Dancers," in which cartoonishly distorted hands and arms, undulating fore and aft, contrive to make the vamping tutu wearers seem more ballerino than ballerina. The swelling, curving digits in this image may remind you that the exhibition begins with a smudged ink drawing of Picasso's left hand accompanied by a label informing us that "hands feature prominently in Picasso's early work." They do, and tracking them is among the smaller, but more telling joys of this enormously inspiring show.

http://www.nytimes.com/2011/10/07/arts/design/lines-that-kept-moving-and-knew-no-boundaries.html

Babies Show Sense of Fairness, Altruism as Early as 15 Months



In the preference phase (A), the infant chose one of the two toys - her preferred toy. In the request phase (B), an unfamiliar experimenter asked for a toy while looking directly at the infant. Here, the infant shares her preferred toy, "altruistic sharing." (Credit: Image courtesy of University of Washington)

ScienceDaily (Oct. 7, 2011) — A new study presents the first evidence that a basic sense of fairness and altruism appears in infancy. Babies as young as 15 months perceived the difference between equal and unequal distribution of food, and their awareness of equal rations was linked to their willingness to share a toy.

"Our findings show that these norms of fairness and altruism are more rapidly acquired than we thought," said Jessica Sommerville, a University of Washington associate professor of psychology who led the study.

"These results also show a connection between fairness and altruism in infants, such that babies who were more sensitive to the fair distribution of food were also more likely to share their preferred toy," she said.

The study has implications for nurturing human egalitarianism and cooperation. The journal *PLoS ONE* published the findings online Oct. 7, 2011. Co-author is Marco Schmidt, a doctoral student at the Max Planck Institute for Evolutionary Anthropology.

Previous studies reveal that 2-year-old children can help others -- considered a measure of altruism -- and that around age 6 or 7 they display a sense of fairness. Sommerville, an expert in early childhood development, suspected that these qualities could be apparent at even younger ages.

Babies around 15 months old begin to show cooperative behaviors, such as spontaneously helping others. "We suspected that fairness and altruism might also be apparent then, which could indicate the earliest emergence of fairness," Sommerville said.

During the experiment, a 15-month old baby sat on his or her parent's lap and watched two short videos of experimenters acting out a sharing task. In one video an experimenter holding a bowl of crackers distributed the food between two other experimenters. They did the food allocation twice, once with an equal allotment of crackers and the other with one recipient getting more crackers.

The second movie had the same plot, but the experimenters used a pitcher of milk instead of crackers.

Then the experimenters measured as the babies -- 47 in all who were tested individually -- looked at the food distributions. According to a phenomenon called "violation of expectancy," babies pay more attention when they are surprised. Similarly, the researchers found that babies spent more time looking if one recipient got more food than the other.

"The infants expected an equal and fair distribution of food, and they were surprised to see one person given more crackers or milk than the other," Sommerville said.

To see if the babies' sense of fairness related to their own willingness to share, the researchers did a second task in which a baby could choose between two toys: a simple LEGO block or a more elaborate LEGO doll. Whichever toy the babies chose, the researchers labeled as the infant's preferred toy.

Then an experimenter who the babies had not seen before gestured toward the toys and asked, "Can I have one?" In response, one third of the infants shared their preferred toy and another third shared their non-preferred toy. The other third of infants did not share either toy, which might be because they were nervous around a stranger or were unmotivated to share.

"The results of the sharing experiment show that early in life there are individual differences in altruism," Sommerville said.

Comparing the toy-sharing task and the food-distribution task results, the researchers found that 92 percent of the babies who shared their preferred toy -- called "altruistic sharers" -- spent more time looking at the unequal distributions of food. In contrast, 86 percent of the babies who shared their less-preferred toy, the "selfish sharers," were more surprised, and paid more attention, when there was a fair division of food.

"The altruistic sharers were really sensitive to the violation of fairness in the food task," Sommerville said. Meanwhile, the selfish sharers showed an almost opposite effect, she said.

Does this mean that fairness and altruism are due to nature, or can these qualities be nurtured? Sommerville's research team is investigating this question now, looking at how parents' values and beliefs alter an infant's development.

"It's likely that infants pick up on these norms in a nonverbal way, by observing how people treat each other," Sommerville said.

The National Institute of Child Health and Human Development funded the study.

Story Source:

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

Journal Reference:

1. Marco F. H. Schmidt, Jessica A. Sommerville. **Fairness Expectations and Altruistic Sharing in 15-Month-Old Human Infants**. *PLoS ONE*, 2011; 6 (10): e23223 DOI: 10.1371/journal.pone.0023223

http://www.sciencedaily.com/releases/2011/10/111007161636.htm

Cutting the cord: how the world's engineers built Wi-Fi

By Iljitsch van Beijnum and Jaume Barcelo | Published 2 days ago

In the 1980s, even before connectivity to the Internet became commonplace, people realized that connecting a group of computers together in a local area network (LAN) made those computers much more useful. Any user could then print to shared printers, store files on file servers, send electronic mail, and more. A decade later, the Internet revolution swept the world and LANs became the on-ramp to the information superhighway. The LAN technology of choice was almost universally Ethernet, which is terrific apart from one big downside: those pesky wires.

In the late 1990s, the Institute of Electrical and Electronics Engineers (IEEE) solved that problem with their 802.11 standard, which specified a protocol for creating wireless LANs. If ever the expression "easier said than done" applied, it was here. Huge challenges have been overcome in the past 15 years to get us to the point where reasonably reliable, fast, and secure wireless LAN equipment can today be deployed by anyone, and where every laptop comes with built-in Wi-Fi. But overcome they were—and here's how.

Early Aloha

The journey started back in the early 1970s. The University of Hawaii had facilities scattered around different islands, but the computers were located at the main campus in Honolulu. Back then, computers weren't all that portable, but it was still possible to connect to those computers from remote locations by way of a terminal and a telephone connection at the blazing speed of 300 to 1200 bits per second. But the telephone connection was both slow and unreliable.

A small group of networking pioneers led by Norman Abramson felt that they could design a better system to connect their remote terminals to the university's central computing facilities. The basic idea, later developed into "AlohaNET," was to use radio communications to transmit the data from the terminals on the remote islands to the central computers and back again. In those days, the well-established approach to sharing radio resources among several stations was to divide the channel either into time slots or into frequency bands, then

assign a slot or band to each of the stations. (These two approaches are called time division multiple access [TDMA] and frequency division multiple access [FDMA], respectively.)

Obviously, dividing the initial channel into smaller, fixed-size slots or channels results in several lower-speed channels, so the AlohaNET creators came up with a different system to share the radio bandwidth. AlohaNET was designed with only two high-speed UHF channels: one downlink (from Honolulu) and one uplink (to Honolulu). The uplink channel was to be shared by all the remote locations to transmit to Honolulu. To avoid slicing and dicing into smaller slots or channels, the full channel capacity was available to everyone. But this created the possibility that two remote stations transmit at the same time, making both transmissions impossible to decode in Honolulu. Transmissions might fail, just like any surfer might fall off her board while riding a wave. But hey, nothing prevents her from trying again. This was the fundamental, ground-breaking advance of AlohaNET, reused in all members of the family of protocols collectively known as "random access protocols."

The random access approach implemented in the AlohaNET represented a paradigm shift from a voice network approach to a data network. The traditional channel sharing techniques (FDMA and TDMA) implied the reservation of a low speed channel for every user. That low speed was enough for voice, and the fact that the channel was reserved was certainly convenient; it prevented the voice call from being abruptly interrupted.

But terminal traffic to the central computers presented very different requirements. For one thing, terminal traffic is bursty. The user issues a command, waits for the computer to process the command, and looks at the data received while pondering a further command. This pattern includes both long silent periods and peak bursts of data.

The burstiness of computer traffic called for a more efficient use of communication resources than what could be provided by either TDMA or FDMA. If each station was assigned a reserved low-speed channel, the transmission of a burst would take a long time. Furthermore, channel resources would be wasted during the long silent periods. The solution was a concept that was implemented by AlohaNET's random access protocol that is central to data networks: statistical multiplexing. A single high speed channel is shared among all the users, but each user only uses it only some of the time. While Alice is carefully examining the output of her program over a cup of tea, Bob could be uploading his data to the central computer for later processing. Later, the roles might be reversed as Alice uploads her new program while Bob is out surfing.

To make this multiplexing work, the team needed a mechanism that would allow the remote stations to learn about the failure of their initial transmission attempt (so that they could try again). This was achieved in an indirect way. Honolulu would immediately transmit through the downlink channel whatever it correctly received from the uplink channel. So if the remote station saw its own transmission echoed back by Honolulu, it knew that everything went well and Honolulu had received the transmission successfully. Otherwise, there must have been a problem, making it a good idea to retransmit the data.

Standards wars

"The wonderful thing about standards is that there are so many of them to choose from." Grace Hopper, as per the UNIX-HATERS Handbook (PDF) page 9 or 49.

By the end of the last century, two standards were competing head to head in the wireless local area network arena. The American alternative, developed by the IEEE, relied on simpler, more straightforward approaches. The alternative, proposed by the European Telecommunications Standards Institute (ETSI), was more sophisticated, featuring higher data rates and traffic prioritization for service differentiation. Vendors favored the easier to implement IEEE alternative, ignoring all optional features.

Obviously, a simpler approach had the advantage of a shorter time-to-market, which was critical for obtaining substantial market share and which paved the way for the ultimate success of the IEEE specification over the one standardized by ETSI. The IEEE 802.11 standard in question belongs to the 802 standard family that also includes IEEE 802.3 (Ethernet). As time passed, the IEEE 802.11 standard was refined to incorporate some features that were present in the early ETSI proposal, such as higher data rates and service differentiation.

Photo illustration by Aurich Lawson

Spreading the spectrum to avoid industry, science, and medicine

The whole point of a local area network (LAN) is that everyone gets to build their own *local* system without having to coordinate with anyone else. But for radio spectrum, tight regulation is the norm in order to avoid undue interference between different users. Wi-Fi sidesteps the need for such regulation, and the need to pay for radio spectrum, by shacking up with microwave ovens, cordless phones, Bluetooth devices, and much more in the unlicensed 2.4GHz industrial, scientific, and medical (ISM) band.

The original 802.11 specification published in 1997 worked at speeds of 1 and 2Mbps over infrared—though this was never implemented—or by using microwave radio on the 2.4GHz ISM band. Users of the ISM band are required to use a spread spectrum technique to avoid interference as much as possible. Most modulation techniques put as many bits in as few Hertz of radio spectrum as possible, so the available radio bandwidth is used efficiently. Spread spectrum does exactly the opposite: it spreads the signal out over a much larger part of the radio band, reducing the number of bits per Hertz. The advantage of this is that it effectively dilutes any narrow-band interference.

Frequency hopping

The simplest spread spectrum modulation technique is frequency hopping—obsolete now in Wi-Fi—which is exactly like it sounds: the transmission quickly hops from one frequency to another. Frequency hopping was invented several times over the first half of the 20th century, most notably by actress Hedy Lamarr and composer George Antheil. Through her first husband (of six), Lamarr became interested in the problem of how to guide torpedos in a way that resists to jamming and even detection by the enemy. Frequency hopping can help resist jamming, but quickly changing frequencies only works if the sender and receiver operate in perfect sync.

Antheil, who had created the composition Ballet Mécanique for a collection of synchronized player pianos, contributed the synchronization based on a piano roll. A 1942 patent for frequency hopping was granted to Lamarr and Antheil, but the significance of the invention wouldn't be recognized until the 1990s, when the wireless revolution got underway.

802.11 direct-sequence spread spectrum

The 1997 version of the 802.11 standard allows for 1 or 2Mbps direct-sequence spread spectrum (DSSS) modulation. Rather than moving a narrowband transmission across the 2.4GHz band, DSSS transmits a signal that occupies a much bigger portion of the band, but does so continuously. The underlying data signal in a DSSS transmission is of relatively low bandwidth compared to the DSSS radio bandwidth. Upon transmission, the data signal gets spread out and upon reception the original data signal is recovered using a correlator, which reverses the spreading procedure. The correlator gets rid of a lot of narrowband interference in the process.

It's a bit like reading a book at the beach. Sand on the pages will make the text harder to read. To avoid this, you could bring a book with big letters and then hold it at a larger distance than usual. The letters then appear at the normal size, but the sand grains are smaller relative to the letters, so they interfere less.

IEEE 802.11-1997 uses a symbol rate of 1MHz, with one or two bits per symbol encoded through differential binary or quadrature phase-shift keying (DBPSK or DQPSK), where the phase of a carrier signal is shifted to encode the data bits. ("Differential" means that it's not the absolute phase that matters, but the difference relative to the previous symbol. See our feature on DOCSIS for more details about how bits are encoded as symbols.)

The 1MHz DBPSK/DQPSK signal is then multiplied with a pseudorandom signal that has 11 "chips" for each symbol (for a chiprate of 11MHz). When transmitted over the channel, the spectrum is flattened because the chiprate is higher than the bitrate. When such a wide signal suffers narrowband interference, the impact is low since most of the transmitted signal remains unaffected. The receiver takes the incoming sequence of chips and multiplies it by the same pseudo-random sequence that was used by the transmitter. This recovers the original PSK-modulated signal.

802.11b: complementary code keying

Being able to transfer data wirelessly at speeds topping out not much higher than 100 kilobytes per second is impressive from the perspective that it works at all, but for real-world applications, some extra speed would be helpful. This is where 802.11b comes in, which specified 5.5Mbps and 11Mbps bitrates in 1999.

Simply increasing the symbol rate and, along with it, the DSSS chiprate, would allow for higher bitrates but would use more radio spectrum. Instead, 802.11b encodes additional data bits in the DSSS chipping sequence, using a modulation scheme called complementary code keying (CCK). The 5.5Mbps rate uses four 8-bit chipping sequences (encoding two bits), while the 11Mbps rate uses 64 (six bits). Together with the two DQPSK bits, this adds up to four or eight bits per symbol with a 1.375MHz symbol rate.

802.11a: orthogonal frequency-division multiplexing

For 802.11a (1999), the IEEE selected a very different technology than DSSS/CCK: orthogonal frequency division multiplexing (OFDM). DSSS is a single-carrier approach since there is a single high-rate (which means wideband) signal modulating the carrier. This has some drawbacks, as a wide-band channel presents different behaviors at different frequencies and needs to be equalized. It is far more convenient to send a large number of carriers and use low-rate (narrowband) signals to modulate each of them. It wasn't until powerful digital signal processors (DSPs) were available that the inverse fast fourier transform (IFFT) algorithm could be used to pack a large number of subcarriers very closely (in frequency) without too much mutual interference.

Rather than have a single signal occupy a whopping 22MHz of radio spectrum as with DSSS, 802.11a transmits 48 data-carrying subcarriers over 20MHz. Because there are so many subcarriers, the bit and symbol rates for each of them are quite low: the symbol rate is one every 4 microseconds (250kHz), which includes a 800-nanosecond guard interval between symbols. The low symbol rate and the guard time for each subcarrier are OFDM's secret weapons. These allow it to be isolated from reflections or multipath interference. 2.4GHz radio waves have a tendency to bounce off of all kinds of obstacles, such that a receiver will generally get multiple copies of the transmitted signal, where the reflections are slightly delayed. This is a phenomenon some of us remember from the analog TV days, where it showed up as ghosting.

A problem with radio transmission is that signals invariably "echo" across the radio band, with copies of the intended transmission also appearing on higher and lower frequencies, causing interference for neighboring

transmissions. This makes it extremely challenging to transmit signals close together in frequency—which is of course exactly what OFDM does. It gets away with this because the carrier frequencies and symbol rates are chosen such that the spikes in the frequency band are "orthogonal": just where one transmission is most powerful, all other transmissions are magically silent. It's similar to how WWI era military aircraft were able to shoot through the arc of the propellor; both the propellor and the machine gun bullets potentially occupy the same space, but they're carefully timed not to interfere.

With techniques like BPSK, QPSK, 16QAM, or 64QAM (1, 2, 4, or 6 bits per symbol), this adds up to between 250 kbps and 1.5Mbps per subcarrier. The total raw bitrate for all 48 subcarriers is thus 12 to 72Mbps.

Unlike 802.11-1997 and 802.11b, 802.11a uses the 5GHz ISM band rather than the 2.4GHz ISM band. Although it took a while to sort out 5GHz availability around the world—which didn't exactly help 802.11a deployment—the 5GHz band has a lot more room than the cramped 2.4GHz band, with fewer users. 5GHz signals are more readily absorbed so they don't reach as far. This is often a downside, but it can also be an advantage: neighboring networks don't interfere as much because the signals don't pass through walls and floors that well.

Although 802.11a saw some adoption in the enterprise space, it wasn't a runaway success. What was needed was a way to bring 802.11a speeds to the 2.4GHz band in a backward compatible way. This is exactly what 802.11g (2003) does by using 802.11a-style OFDM in the 2.4GHz band. (though it adds additional "protection" mechanisms [discussed later] for 802.11b coexistence.)

802.11n: much, much, much more speed

Surprisingly, 802.11g didn't satiate the need for more speed. So the IEEE went back to the drawing board once again to find new ways to push more bits through the ether. They didn't come up with any new modulations this time around, but rather used several techniques that add up to much higher bitrates, and, more importantly, much better real-world throughput. First, the number of OFDM subcarriers was increased to 52, which brought the raw bitrate up to 65Mbps.

The second speed increase came from MIMO: multiple-input/multiple-output. With MIMO, a Wi-Fi station can send or receive multiple data streams through different antennas at the same time. The signal between each combination of send and receive antennas takes a slightly different path, so each antenna sees each transmitted data stream at a slightly different signal strength. This makes it possible to recover the multiple data streams by applying a good deal of digital signal processing.

All 802.11n Wi-Fi systems except mobile phones support at least two streams, but three or four is also possible. Using two streams increases the bitrate to 130Mbps.

The third mechanism to increase speed is an option to use "wide channels." 40MHz rather than 20MHz channels allow for 108 subcarriers, which brings the bitrate to 270Mbps with 2x2 MIMO (two antennas used by the sender and and two antennas used by the receiver). Optionally, the guard interval can be reduced from 800 to 400 nanoseconds, adding another 10 percent speed increase, bringing the total bitrate to 300Mbps for 2x2 MIMO, 450Mbps for 3x3 MIMO, and 600Mbps for 4x4 MIMO. However, as the 2.4GHz band is already very crowded, some vendors only implement wide channels in the 5GHz band.

Last but not least, 802.11n makes it possible to transmit multiple payloads in one packet and use block acknowledgments, reducing the number of overhead bits that must be transmitted.

Propagation and interference

Wired communication uses a tightly controlled medium for signal propagation. A wire has predictable properties and is, to a certain extent, isolated from the outer world. In wireless communication, the situation is exactly the opposite. The behavior of the transmission medium is quite unpredictable, and interference is a fact of life. Radio engineers resort to statistics to describe radio propagation—accurately modeling it is too complex. The channel attenuates (dampens) the signal and also introduces dispersion (spreading out) across time and frequency. Only under ideal circumstances in free, open space does the signal simply propagate from the transmitter to the receiver following a single path, making the problem amenable to analysis.

Obviously, the typical propagation conditions are very far from ideal. Radio waves hit all kinds of objects that cause reflections. The signal that arrives at the receiver is the sum of a large number of signals that followed different paths. Some signals follow a short path and thus arrive quickly. Others follow a longer path, so it takes them extra time to arrive. Drop a marble in a sink filled with water, and you will see waves propagating and reflecting in all directions, making the overall behavior of the waves hard to predict. In some places, two different fronts of waves add up, creating a stronger wave. In other places, waves coming from different directions cancel each other out.

Then there's interference. It's not unlikely that your neighbor also has some Wi-Fi equipment. And there are other devices, such as Bluetooth devices or microwave ovens, that operate in the same band as Wi-Fi. Obviously, all this interference adds to the above-mentioned problems to make it even more difficult to correctly detect and decode the signal we want.

The bottom line is that the signal quality that we are going to observe is rather unpredictable. The best we can do is to be ready to deal with signal quality heterogeneity. If the propagation conditions are good and interference is low, we can transmit at high data rates. In challenging propagation conditions, with lots of interference, we have to fall back to low data rates. This is why Wi-Fi devices offer different connection speeds and constantly adapt the data rate to the environment conditions.

Channels and overlap

Wi-Fi in the 2.4GHz ISM band uses 14 channels at 5MHz intervals. (Channels 12 and 13 are not available in North America and there are other country-specific peculiarities. Channel 14 is a special case.) However, DSSS transmissions are approximately 22MHz wide, so the 802.11b standard specifies that two transmissions should be 25MHz apart to avoid undue interference. This is the source of the common wisdom that you should use channels 1, 6, and 11 to avoid overlap. However, real life is much messier than what can be encapsulated in such a simple recommendation.

Receivers typically aren't as good as the IEEE wants them to be, with the result that a sufficiently strong signal can cause interference even if it's more than 5 channels away. But using channels that slightly overlap often works just fine, especially if the different transmitters are relatively far apart. So if you have four Wi-Fi base stations, it's probably better to use channels 1-4-8-11 in North America rather than have two base stations sit on the same channel in the 1-6-11 configuration. In Europe and many other parts of the world 1-5-9-13 is possible, which provides the 20MHz separation needed for 802.11g and 802.11n. In the 5GHz band where 802.11a—and sometimes 802.11n—lives, the channels are 20MHz wide, although they're still numbered in 5MHz intervals (so three quarters of the channel numbers remain unused). Some 5GHz channels are only available if they are not used for other purposes such as radar, so they're only selected when setting the channel selection to "auto." This also varies by country.

Of course, these days few of us have the luxury to slice and dice a wide open 2.4GHz band. It's not uncommon to see a dozen or more Wi-Fi networks in a residential neighborhood. Fortunately, just because they're there doesn't mean that all of these networks are going to interfere much. Most networks are idle most

of the time—statistical multiplexing for the win. However, if you find yourself stuck between active Wi-Fi networks, it can pay to experiment a bit.

In some cases, the best choice is to select the same channel your neighbors are using. That way, your network and theirs will politely take turns transmitting. Waiting for your neighbor's transmissions will reduce your maximum throughput, but they also wait for you, so you get to transmit at maximum speed when it's your turn. Alternatively, if you choose a channel that heavily overlaps with a neighbor's network that is both strong and active, the two networks won't "see" each other and rather than take turns, generate interference when they both transmit at the same time, reducing the usable transmission rates.

Then again, in the case of a more remote network, overlapping can be the better choice than sharing the same channel. The added distance reduces the interference, so transmission speed remains high and your network won't wait for the other's transmissions to be completed. All else being equal, choose channel 1 or the highest available option. That way, overlap can only come from one direction.

Who gets to transmit: media access control

With only one radio channel for sending and receiving and multiple devices that may have data to transmit, obviously, some protocol is needed for the devices to play nice and take turns transmitting. Imagine that you are participating in a conference call. Having all the participants in the call talking at the same time is not very effective. Ideally, the different participants that have something interesting to say should take turns speaking. Those that have nothing to say can simply remain silent.

A natural courtesy rule is not to interrupt each other—in other words, to wait for the other party to finish before talking. Therefore, the different parties listen to medium before talking, and refrain from saying anything when someone else is speaking. In wireless network jargon this is called "carrier sense multiple access" (CSMA). CSMA solves part of the problem, but CSMA still allows two devices to start transmitting at the same time after a previous transmission ends, creating a collision. And unlike with wired Ethernet, Wi-Fi devices can't detect collisions as they happen.

The solution to this problem is that, after waiting until an ongoing transmission has finished, stations that want to transmit then wait for an additional random amount of time. If they're lucky, they'll choose a different random time, and one will start the transmission while the other is still waiting, and a collision is avoided. This solution is aptly named "collision avoidance" (CA). The 802.11 media access control layer combines CSMA and CA, shortened to CSMA/CA. Devices also observe a random time between packets if they have multiple packets to transmit, in order to give other systems a chance to get a word in.

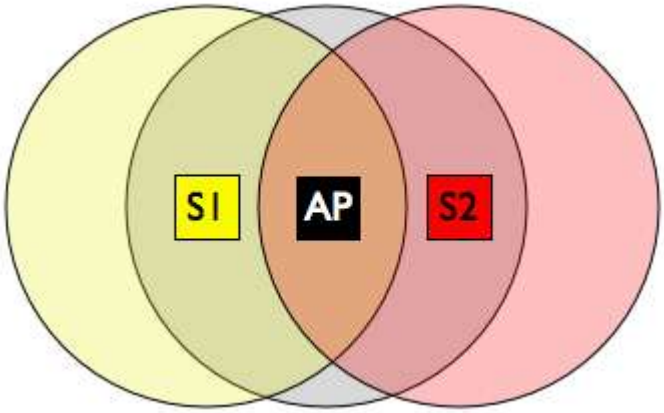
The implementation of CSMA/CA used in IEEE 802.11 is called the "distributed coordination function" (DCF). The basic idea is that before transmitting a packet, stations choose a random "backoff" counter. Then, as long as the channel is deemed idle, the stations decrease their backoff counter by one every slot time. The slot time is either 9 or 20 microseconds, depending on the 802.11 version at hand. Eventually, the backoff counter reaches zero and at that point the station transmits its packet. After the transmission, the station chooses a new backoff value and the story repeats itself. This way, collisions only occur when two stations choose the same random backoff value.

If the packet doesn't make it to the intended receiver, it's retransmitted. Of course, a transmitter needs to know whether a transmission has been successful or not to decide whether a retransmission is necessary. For this reason, a IEEE 802.11 station immediately sends back an acknowledgment packet after receiving a regular (unicast) data packet. (This is not done for multicast/broadcast packets because there is more than one receiver. Those packets are simply sent at a very low rate.) If a transmitter fails to receive this acknowledgement, it will schedule the packet for retransmission. Once in a while, an acknowledgment gets lost, so an unnecessary retransmission happens, leading to a duplicated packet.

Fairness

DCF is a "fair" protocol in the sense that all the stations have the same opportunity to transmit. This concept of fairness results in a somewhat bizarre behavior which is known as the "performance anomaly," which boils down to "the slowest sets the pace." If you are right next to your access point and enjoy good channel conditions, you can wirelessly communicate at a relatively high speed, say 54Mbps. Now, if someone else connects to the same access point from a remote room or office, he would use a slower data rate, say 6Mbps. And—surprise!—the speed you get drops to almost what you would get if you were using a 6Mbps rate yourself. The reason? DCF is just being "fair," and you both will perceive a similar performance. The number of transmission attempts is going to be the same for both. The only difference is that the remote device will occupy the channel for a long time (since it's using a low data rate) while the closer device will occupy the medium for a short time each transmission attempt. It's a bit like sharing a lane with a big, slow truck. Some may argue that this is a very particular concept of fairness.

CSMA assumes that all stations can see each other's transmissions. This is not necessarily true. It's possible that two stations interfere with each other even though they can't detect each other's transmissions. For instance, when there is an obstacle between the two transmitting stations that prevents them from hearing each other and they both transmit to the same access point which has a clear channel to each of them. Or they may simply be out of range of each other. This is called the "hidden node problem."



The hidden node problem.

Say station 1 starts to transmit. Station 2 doesn't see station 1's transmission, so it also starts to transmit. The access point hears both transmissions but fails to decode either of them because they overlap and interfere heavily with each other. The access point doesn't send any acknowledgments, so the two stations retransmit and collide again. This continues and the effective throughput of the network is almost zero.

This problem can be alleviated using a four-way handshake, which consists of four different messages: request-to-send (RTS), clear-to-send (CTS), data, and acknowledgement (ACK). A station which is ready to transmit sends an RTS which contains a field that indicates how long the channel has to be reserved. Upon correct reception, the intended receiver—the access point—issues a CTS message that also contains the duration of the channel reservation. Ideally, this CTS will be received by all the potential interferers that are in the transmission range of the AP, which all defer their transmission to prevent collisions, so the the station that had initially issued the RTS transmits its data packet without incident and the access point sends an acknowledgment.

Since the RTS, CTS, and ACK packets are short signaling packets, the chances that those encounter errors and collisions is low. If a collision occurs between two RTS packets, it will be a short collision so not too

much channel time is wasted. By using the four-way handshake, collisions among long data packets are avoided. But the extra RTS/CTS packets add additional overhead, reducing the channel time available for user data transmission. So RTS/CTS is only enabled for long packets, and is often disabled completely.

Overhead and the MAC bottleneck

Ever wondered why you can hardly squeeze 30Mbps out of your 54Mbps hardware? Blame the MAC bottleneck. First, transmissions are delayed a random amount of time which necessarily means that there are moments when the medium is idle and, therefore, channel time is wasted. Channel time is also wasted when a collision occurs. And even successful transmissions come with a certain amount of overhead. Wireless transmissions are preceded by training sequences or preambles that allow the receiver to adapt to the channel conditions and to synchronize with the timing of the incoming data symbols. The acknowledgement also represents some overhead. Additionally, switching from transmission to reception and vice versa is not free; the hardware needs some time to reconfigure. It also doesn't help that Wi-Fi transmits entire Ethernet frames rather than just the IP packets inside Ethernet frames.

All this overhead is acceptable for long packets, but as the packets become shorter, the fixed amount of overhead per packet gets relatively larger. The problem is that as physical data rates increase as the technology evolves, the packets effectively become shorter so the relative overhead increases. For a short packet, the time wasted in the form of overhead can be larger than the time that is used for actual data transmission! This is the MAC bottleneck problem: at a given point, no matter how much the physical data rate increases, the user will not enjoy any significant performance advantage.

The problem was particularly acute with the release of the IEEE 802.11n standard amendment that uses MIMO, wider channels, and more efficiency in general to accommodate physical layer speeds up to 600Mbps. Despite this impressive number, the MAC bottleneck would have limited the real-world performance to less than that of 100Mbps wired Ethernet. This was clearly unacceptable.

The solution was to aggregate multiple packets into larger packets with the consequent reduction in terms of relative overhead. Each time that a station obtains access to the channel, it transmits several aggregated packets, and pays the overhead tax only once. This simple scheme was crucial to avoid the MAC bottleneck and break the 100Mbps real-world throughput barrier in 802.11n.

Protection against slow neighbors

It is often claimed that 802.11 networks operate at the rate of the slowest device that is connected. Fortunately, that's not true, although the performance anomaly mentioned above kicks in when the slower devices start to transmit. Also, in a mixed mode network, the faster devices do have to slow down to varying degrees to coexist with older devices. This started with 802.11b, which introduced shorter headers compared to the original 1 and 2Mbps 802.11. But those shorter headers can only be used when all the systems are 802.11b systems. More problematic is the coexistence between 802.11b and 802.11g, because 802.11b systems see OFDM signals as meaningless noise.

So if one or more 802.11b systems are present on a channel, OFDM transmissions are "protected" by DSSS RTS/CTS packets (or just CTS packets). The CTS packet announces a duration that encompasses the DSSS CTS packet, the OFDM data packet, and the OFDM acknowledgment for the data packet so DSSS stations remain quiet during that time. Protection kicks in if any DSSS stations are detected—even if they're part of some other network down the street at the edge of wireless range that happens to use the same channel. This protection seriously cramps 802.11g's style; throughput drops by about 50 percent. But without it, DSSS systems may transmit in the middle of an OFDM transmission, to the detriment of both.

Because 802.11a, g, and n all use OFDM modulation, backward compatibility is easier here: part of the MAC header is sent at 802.11a/g speed so older devices know the duration of the transmission. The remaining header fields and the data are then transmitted at 802.11n speeds. Because 802.11a networks are relatively rare, it's usually no problem to run in 802.11n-only mode on the 5GHz band, but doing so on the 2.4GHz band may not be appreciated by your 802.11g neighbors.

Standardization and certification

So far, we've used the terms Wi-Fi ("wireless fidelity", a play on hi-fi) and IEEE 802.11 interchangeably, but there is a difference. The IEEE is the standardization body in charge of the IEEE 802.11 standard, using long and tedious procedures. For instance, work on the IEEE 802.11n amendment started back in 2002. By 2007, most of the technical details were settled, but it took until 2009 before the new version of the 802.11 standard was official. It doesn't help that the companies that work together in the IEEE are competitors in the marketplace, and that it can be a huge windfall for a company to have its patented technology become part of a standard.

The Wi-Fi Alliance, on the other hand, is an industry consortium that certifies that the hardware is compliant with a specification and can interoperate. The Wi-Fi Alliance performs some tests and (after payment of the relevant fees) certifies a product as being compliant with the specification. Certified products carry a logo that identifies them as standards compliant. Specifications obviously follow the 802.11 standard, but may sometimes require the implementation of certain options, or even non-implementation of deprecated ones, such as WEP.

Security

If you connect your computer to your home router using that trusty UTP cable, it's highly unlikely that your nosy neighbor can spy on your browsing habits. For a wireless connection, the situation can be very different. Radio waves do not recognize property limits; anyone can purchase a directional antenna and collect wireless data from a safe distance. Your cheap neighbor may even take advantage of your broadband connection instead of paying for his own cable or ADSL connection.

To avoid these eventualities, the first versions of the Wi-Fi standard came with "wired equivalent privacy" (WEP) to secure the wireless network. Unfortunately, WEP doesn't exactly live up to its name. WEP was developed back in the days when the US government didn't want strong encryption to be exported, so WEP originally used 40-bit key sizes, which is intentionally way too short to offer much more than an illusion of security. (Later versions support 104-bit keys.)

The 40 or 104 key bits are combined with a 24-bit initialization vector for a total of 64 or 128 bits. The encryption algorithm in WEP is the Rivest Cipher RC4. However, over the years many RC4 weaknesses have been found, to the degree that WEP can now be cracked in minutes. This prompted the Wi-Fi alliance to come up with a new security framework called Wireless Protected Access (WPA), while the IEEE started to work in a new security standard called IEEE 802.11i.

The goal of WPA was to prop up Wi-Fi security without having to replace hardware, while the IEEE's goal was to build something fundamentally better. WPA introduces the Temporal Key Integrity Protocol (TKIP) that reuses the RC4 capabilities of existing Wi-Fi cards, but creates a new encryption key for each packet. This avoided most of the then-known RC4 vulnerabilities. WPA2 is the Wi-Fi Alliance's name for IEEE 802.11i, which uses CCMP, the "counter mode with cipher block chaining message authentication code protocol" (say that three times fast). CCMP is based on the widely used AES encryption algorithm.

Both WPA and WPA2 are available in Personal and Enterprise forms. WPA2 Personal uses a 256-bit pre-shared key (PSK), which is used negotiate the actual packet encryption keys. Obviously those who don't know the PSK aren't allowed access to the network. WPA2 Enterprise uses a plethora of additional protocols to let the user provide a username and password, which are checked against a remote authentication server. Always use only WPA2 with CCMP/AES unless you absolutely need compatibility with very old equipment.

Although wireless communication, especially on the frontier-like ISM band, is fraught with hidden dangers, the vendors working together in the IEEE and Wi-Fi Alliance have managed to successfully shepherd wireless LAN technology from humble beginnings to the reasonably reliable high performance we enjoy today. Every time an obstacle presented itself, new technology was introduced to circumvent it, while the quickly growing market kept prices under pressure. What more could we ask for?

http://arstechnica.com/gadgets/news/2011/10/cutting-the-cord-how-the-worlds-engineers-built-wi-fi.ars

Ancient Climate Change Has Left a Strong Imprint On Modern Ecosystems

The Andes, a topographically variable landscape with low climate-change velocity and high concentrations of small-ranged vertebrate species. (Credit: Dennis Pedersen)

ScienceDaily (Oct. 7, 2011) — As Earth's climate cycles between warm and cool periods, species often must move to stay within suitable conditions. Scientists have now mapped how fast species have had to migrate in the past to keep up with changing climate. They found that small-ranged species – which constitute much of Earth's biodiversity – are concentrated in regions where little migration has been required. Climate change due to human activities will drastically increase the required migration rates in many of these locations, putting their unique faunas at risk.

During the Last Glacial Maximum (21,000 years ago) Earth's climate was much cooler and many species were forced to occupy very different areas than they do today. In northern Europe, for example, many of the species found today are relatively recent arrivals from their refuges in southern Europe. A team of ecologists and computer scientists have asked how fast species around the world have had to migrate to keep up with this massive historical climate change and whether there are differences in the modern communities between places with low and high required migration rates.

Required migration rates were estimated by calculating how fast climate conditions have moved over Earth's surface at a point. This velocity depends on both the rate of temperature change through time and on local topography. On steep topography, a short distance traveled can produce a large difference in temperature, leading to small climate-change velocities.

What happens if a species cannot migrate as fast as it must to keep up with the velocity of climate change? Its range may shrink and, in some cases, the species may go extinct. This is most likely when climate-change

velocity is high relative to species' dispersal abilities. The researchers tested this by mapping patterns of small-ranged species diversity for all terrestrial amphibians, mammals and birds. High concentrations of small-ranged species occurred where velocities were low (for example, the South American Andes), and small-ranged species rarely occurred at all where velocities were high (much of northern Europe, for example). Weak dispersers (amphibians) were most strongly affected by velocity, while the strongest dispersers (birds) were least affected.Within the mammals, bats showed patterns more similar to birds, while non-flying mammals were more like the amphibians. Thus, there appears to be a direct connection between the required migration velocity, a species' ability to disperse in response, and ultimately, the probability that a species will be driven to extinction by climate change.

This research provides the first evidence that past regional climate shifts interact with local topography and species dispersal abilities with long-lasting important consequences for the global distribution of biodiversity.

Anthropogenic climate change is leading to increased climate-change velocities. Moreover, there are several regions in the world including the Amazon basin and much of Africa where velocities have historically been rather low but are expected to increase rapidly in the next 70 years. These areas, by virtue of their historically low velocities, have high concentrations of small-ranged species. These species will likely be at particular risk as velocities increase over the next several decades.

Story Source:

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

Journal Reference:

1. B. Sandel, L. Arge, B. Dalsgaard, R. G. Davies, K. J. Gaston, W. J. Sutherland, J.- C. Svenning. **The Influence of Late Quaternary Climate-Change Velocity on Species Endemism**. *Science*, 2011; DOI: 10.1126/science.1210173

http://www.sciencedaily.com/releases/2011/10/111007102916.htm

The Fantastic and Grisly, Envisioned

By KAREN ROSENBERG

PURCHASE, N.Y. — These are some of the things Dana Schutz has painted: A portrait of herself as an elephant. A cannibal devouring his own face. The autopsied corpse of Michael Jackson. A giant on a dissecting table. A woman stripping a wood floor with her teeth. The last man on earth.

Ms. Schutz has become a reliable conjurer of wickedly grotesque creatures and absurd situations, willed into existence by her vigorous and wildly colorful brush strokes. At 34, she is having a 10-year museum survey, an honor that does not feel at all premature.

The show, at the Neuberger Museum here, is attached to the biannual Roy R. Neuberger Exhibition Prize, which celebrates an artist with an early-career retrospective and a catalog. Titled "Dana Schutz: If the Face Had Wheels," it includes 30 paintings and 12 drawings. After its run at the Neuberger, it will travel to the Miami and Denver Art Museums.

This exhibition comes at a crossroads for Ms. Schutz, who recently changed dealers for the first time, moving from Zach Feuer, who had represented her since she received a master of fine arts degree from Columbia

University in 2002, to Friedrich Petzel. There she joins a formidable stable of abstract and quasifigurative painters: Charline von Heyl, Nicola Tyson and Maria Lassnig, among others.

The Neuberger show gives Ms. Schutz an occasion to look back as she leaps ahead, and gives us a chance to catch up to her hyperactive imagination (which has been compared, not unreasonably, to David Foster Wallace's).

Installed more or less chronologically, the show fills two galleries (one large, one small) with equal aplomb, and underscores Ms. Schutz's extraordinary versatility. She has never been intimidated by color or scale.

The show opens with "Sneeze" (2001), a small painting in which mucus spews from a woman's snoutlike nose. The subject appealed to Ms. Schutz because "you can't paint it from observation, but everyone has experienced it," as she says in the catalog interview with the museum's chief curator, Helaine Posner.

Frank, Ms. Schutz's fictional "last man on earth," was no less difficult to observe This problem did not stop her from titling a series "Frank From Observation," inserting herself into the narrative as the last painter (and last woman) on earth. In her hands, a "Survivor"-era conceit turns tragicomic; the sight of a nude and sunburned Frank striking a familiar Odalisque pose, in "Reclining Nude" (2002), gives you hope that painting will endure to the end of our species.

After "Frank," Ms. Schutz turned to painting real people: female indie-rockers, to be specific. Her marvelous P. J. Harvey, "50-Foot Queenie," isn't here, but "Her Arms" (2003) electrifies the sinewy figure of Sonic Youth's Kim Gordon with Day-Glo vertical stripes. If she was looking for role models, Ms. Schutz could certainly have done worse.

The following year, she found her own groove with the "Self-Eaters": figures consuming their own body parts with gleeful abandon. Many saw in these works a metaphor for 21st-century painting, though Ms. Schutz likes to talk about them as collapsing the distinction between artist and subject.

"They could eat themselves and then remake themselves to be any form they wanted to be," she tells Ms. Posner. Either way, the Goyaesque "Face Eater" (2004), with its dislodged eyeballs peering out from a ravenous maw, makes you shiver.

Some of Ms. Schutz's largest paintings also date from around that time, notably "Presentation." Commissioned for P.S. 1 Contemporary Art Center's 2005 "Greater New York" survey, and later purchased by the Museum of Modern Art, it shows a crowd assembled before a monstrous figure who is undergoing some sort of surgery or autopsy. It's a tour de force, dazzling in its mosiaclike application of color and maddening in its ambiguous approach to mob psychology.

Where could Ms. Schutz go from there? Into the future, or rather the present, as documented for the benefit of a futuristic species. In paintings like "How We Would Give Birth" and "How We Would Talk," she created a sort of Golden Record, a database of "proposals for a future fictive audience who don't do basic human things anymore."

In the childbirth scene, a woman distracts herself from the bloody mess of labor by staring at a landscape on the wall. Art as anesthetic? In Ms. Schutz's universe, it's not a paradox.

Then comes a bizarre series of paintings in which some unseen force has entered the scene from the right side and gnawed away at the figures, leaving their backgrounds intact. "Gouged Girl," for instance, resembles the half-eaten chunk of watermelon that lies on her picnic blanket.

These characters are ultimately too passive to hold Ms. Schutz's interest, or ours. But action returns with a vengeance in the "Verbs" paintings, from 2009. Here, in works like "Swimming, Smoking, Crying" and "Shaking, Cooking, Peeing," Ms. Schutz's protagonists multitask to ruinous effect. And the more recent "Tourette's" series brings us back to the involuntary movement of "Sneeze"; Ms. Schutz's figures seemingly can't help poking one another in the eye, or scraping their teeth against the ground.

Again and again Ms. Schutz has challenged herself to come up with a subject that's too awkward, gross, impractical or invisible to paint. But she has yet to find one that stumps her.

"Dana Schutz: If the Face Had Wheels" continues through Dec. 18 at the Neuberger Museum of Art, Purchase College, State University of New York, 735 Anderson Hill Road, Purchase; (914) 251-6100, neuberger.org.

http://www.nytimes.com/2011/10/07/arts/design/dana-schutz-at-neuberger-museum-review.html?ref=design

Weird Science is nice to the nurses in order to get more morphine

By John Timmer | Published 2 days ago

Anyone you don't like is just whining: Alternately, if you want better pain management, be nice to the hospital staff. A small study population was given a pictures of a set of patients, associated with short notes describing them. Some of these were fairly neutral, while others (egoistic, hypocritical, or arrogant) were decidedly negative. They were then shown videos in which these same patients acted out various levels of pain. The people who had negative notes attached to their profile were consistently rated as being in less pain, and the subjects had a harder time making relative judgements about their pain. In short, if you are a pain, you're more likely to be left in pain.

Decisions decisions... fewer kids, or getting eaten?: In many species, males tend to hang around a female after they've mated with them (we'll leave it to the readers to argue over whether that applies to humans). This has been interpreted as a way of keeping her from going on to mate with other males. But, at least among the crickets, this behavior is anything but selfish. Researchers tracked crickets using infrared cameras, and found that, when they're on their own, males and females suffer roughly equal rates of predation. But, when they're together for mating, the male lets the female have access to his burrow when they're attacked. Her survival goes up; he's much more likely to be eaten.

Obvious result of the week: envy fuels workplace sabotage. The result itself isn't surprising. If workers are feeling isolated from their peers and envious of some of them, those disgruntled people are more likely to sabotage the work of their peers. The real shock was where the researchers found this effect: in a hospital. I'm not sure I really want to know what ended up being sabotaged there. In any case, they performed a second study with groups of business students, also found that the envious, detached students were more likely to sabotage their peers. In general, however, they're only likely to actually act on their feelings if sabotage rates

are already perceived to be high within their group. So, it seems that "everybody else is doing it" is acting as a license for bad behavior here.

Isolation may be bad, but togetherness has its own problems: If isolation and envy cause this sort of harmful behavior, you might think that the best solution is to create an environment where everyone feels that they're in it together. Unfortunately, that may have a downside, too: bribery. A study correlated Transparency International's survey of bribe frequency, and correlated that with a separate international survey that rated a the degree to which a country's citizens had collectivist tendencies. Once adjusted for national wealth, it appears that the higher the sense of collectivism, the greater the frequency of bribes.

This group also turned to students, having them perform tasks in which they circled either singular or collective pronouns (literally, I vs. We). Those that were given the collective pronouns were more likely to offer a bribe when put in a fictional business scenario afterwards.

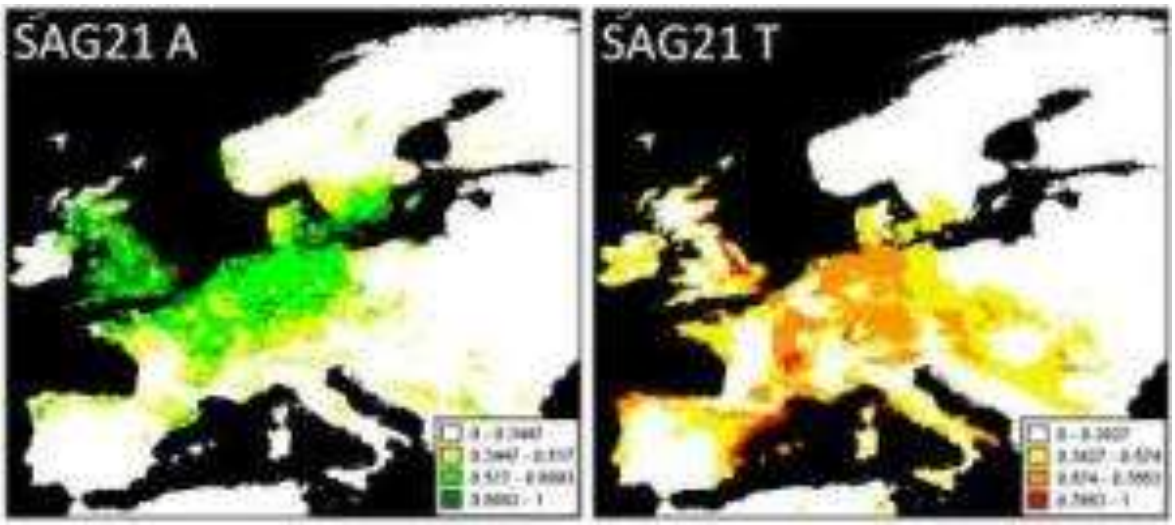
How many different types of virus are there? Check your sewage: There are so many species of bacteria out there that it's simply not realistic to think we can identify them all individually. Instead, researchers are now doing what's termed metagenomics—they simply sequence all the DNA they can find, and then use computer analysis to help them identify how many different species there are in a sample, and where they reside on the tree of life. In a new study, someone's looked at the tree of not-quite-life: viruses. And they didn't have to travel far to get a sample: they looked at untreated sewage. (Samples actually came from Barcelona, where some of the researchers are based, Pittsburgh, where others work, and Addis Ababa, Ethiopia, for no obvious reason whatsoever.)

The results "show that the vast majority of the viruses on Earth have not yet been characterized," and that sewage is the most diverse source of viruses looked at yet. And, incidentally, only a small minority of the known viruses the authors found actually infect humans.

Photograph by Ken Lee

http://arstechnica.com/science/news/2011/10/weird-science-is-nice-to-the-nurses-in-order-to-get-more-morphine.ars

Plants May Have the Genetic Flexibility to Respond to Climate Change



Climate, genome, and 'home court advantage'. Southern variants of the water stress tolerance gene SAG21 (right panel) were associated with low fitness when grown outside of their home range in the northern Finnish site. (Credit: Image courtesy of Brown University)

ScienceDaily (Oct. 6, 2011) — Plants may have the genetic flexibility to respond to climate change. In experiments with the common European plant *Arabidopsis thaliana,* a team of researchers led by Brown University scientists learned that climate is the agent that determines the suite of genes that gives the plant the best chance of surviving and reproducing throughout its natural range. The finding may unlock the molecular basis for other plants' adaptability to climate change. Results appear in *Scienc*e.

In the face of climate change, animals have an advantage over plants: They can move. But a new study led by Brown University researchers shows that plants may have some tricks of their own.

In a paper published in *Science*, the research team identifies the genetic signature in the common European plant *Arabidopsis thaliana* that governs the plant's fitness -- its ability to survive and reproduce -- in different climates. The researchers further find that climate in large measure influences the suite of genes passed on to *Arabidopsis* to optimize its survival and reproduction. The set of genes determining fitness varies, the team reports, depending on the climate conditions in the plant's region -- cold, warm, dry, wet, or otherwise.

"This is the first study to show evolutionary adaptation for *Arabidopsis thaliana* on a broad geographical scale and to link it to molecular underpinnings," said Johanna Schmitt, director of the Environmental Change Initiative at Brown and an author on the paper. "Climate is the selective agent."

The researchers believe that by identifying the genetic signatures that mark *Arabidopsis'* response to changing climate, scientists may understand how climate may cause the re-engineering of the genetic profiles of other plants. "There is still evolutionary flexibility to help plants take one direction or another," said Alexandre Fournier-Level, a postdoctoral researcher at Brown and the paper's first author. "It gives us good hope to see, yes, it's adapting."

"This was a truly massive undertaking, tracking more than 75,000 plants in the field, from near the arctic circle to the Mediterranean coast," said Amity Wilczek, a former postdoctoral researcher in Schmitt's lab now on the faculty at Deep Springs College. "*Arabidopsis* is an annual plant, so we could measure total lifetime

success of an individual within a single year. We gathered plants from a variety of native climates and grew some of each in our four widely distributed European garden sites. We shipped our harvested plants back to Brown and began the laborious task of counting fruits on these plants. In the end, we were able to assemble a very large and comprehensive dataset that gives us new insight into what it takes for a plant to be succesful in nature under a broad range of climate conditions."

The team then burrowed into the *Arabidopsis* genome to find the molecular mechanisms that might give the plant genetic flexibility to roll with climate punches. To identify variations in the genome among the regional representatives, the researchers carried out a genome-wide association study for survival and fruiting comprising more than 213,000 single-nucleotide polymorphisms. These SNPs, Fournier-Level explained, are like signposts pointing to areas in the genome where survival and reproduction may be emphasized and areas that show variations in the regional representatives' genetic makeup.

From the experiments, the team discovered that the SNPs that determined fitness for *Arabidopsis* in one region are surprisingly different from those associated with the plant's fitness in another region. The team also learned from the experiments that SNP variants -- "alleles" -- associated with high fitness within each field site were locally abundant in that region, demonstrating a kind of home court advantage at the genomic level.

In addition, certain climate variables seemed to control the geographic distribution of fitness-associated SNPs. For example, fitness SNPs in Finland, at the northern range limit, were limited by temperature. In one example presented in the paper, the researchers identify a SNP allele in a water-stress tolerance gene, called SAG21. This allele was common in *Arabidopsis's* Spanish populations, but not in the cool climate of Finland where tests showed plants carrying that allele fared poorly.

"Climate explains the distribution of locally favorable alleles," Fournier-Level explained. "This helps explain how climate shapes distribution."

"We found that the genetic basis of survival and reproduction is almost entirely different in different regions, which suggests that evolutionary adaptation to one climate may not always result in a tradeoff of poor performance in another climate," said Schmitt, the Stephen T. Olney Professor of Natural History and professor of biology and environmental studies. "Thus, the *Arabidopsis* genome may contain evolutionary flexibility to respond to climate change."

Martha Cooper, lab manager in Schmitt's lab, and Magnus Nordborg and Arthur Korte from the Gregor Mendel Institute in Austria contributed to the paper.

The National Science Foundation and the Alexander von Humboldt Foundation funded the work.

Story Source:

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

Journal Reference:

1. A. Fournier-Level, A. Korte, M. D. Cooper, M. Nordborg, J. Schmitt, A. M. Wilczek. **A Map of Local Adaptation in Arabidopsis thaliana**. *Science*, 2011; 334 (6052): 86 DOI: 10.1126/science.1209271

http://www.sciencedaily.com/releases/2011/10/111006141402.htm

Astronomers Find Elusive Planets in Decade-Old Hubble Data

The left image shows the star HR 8799 as seen by Hubble's Near Infrared Camera and Multi-Object Spectrometer (NICMOS) in 1998. The center image shows recent processing of the NICMOS data with newer, sophisticated software. The processing removes most of the scattered starlight to reveal three planets orbiting HR 8799. Based on the reanalysis of NICMOS data and ground-based observations, the illustration on the right shows the positions of the star and the orbits of its four known planets. (Credit: NASA; ESA; STScI, R. Soummer)

ScienceDaily (Oct. 6, 2011) — In a painstaking re-analysis of Hubble Space Telescope images from 1998, astronomers have found visual evidence for two extrasolar planets that went undetected back then.

Finding these hidden gems in the Hubble archive gives astronomers an invaluable time machine for comparing much earlier planet orbital motion data to more recent observations. It also demonstrates a novel approach for planet hunting in archival Hubble data.

Four giant planets are known to orbit the young, massive star HR 8799, which is130 light-years away. In 2007 and 2008 the first three planets were discovered in near-infrared ground-based images taken with the W.M. Keck Observatory and the Gemini North telescope by Christian Marois of the National Research Council in Canada and his team. Marois and his colleagues then uncovered a fourth innermost planet in 2010. This is the only multiple exoplanetary system for which astronomers have obtained direct snapshots.

In 2009 David Lafreniere of the University of Montreal recovered hidden exoplanet data in Hubble images of HR 8799 taken in 1998 with the Near Infrared Camera and Multi-Object Spectrometer (NICMOS). He identified the position of the outermost planet known to orbit the star. This first demonstrated the power of a new data-processing technique for retrieving faint planets buried in the glow of the central star.

A new analysis of the same archival NICMOS data by Remi Soummer of the Space Telescope Science Institute in Baltimore has recovered all three of the outer planets. The fourth, innermost planet is 1.5 billion miles from the star and cannot be seen because it is on the edge of the NICMOS coronagraphic spot that blocks the light from the central star.

By finding the planets in multiple images spaced over years of time, the orbits of the planets can be tracked. Knowing the orbits is critical to understanding the behavior of multiple-planet systems because massive planets can perturb each other's orbits. "From the Hubble images we can determine the shape of their orbits, which brings insight into the system stability, planet masses and eccentricities, and also the inclination of the system," says Soummer.

These results are to be published in the *Astrophysical Journal*.

The three outer gas-giant planets have approximately 100-, 200-, and 400-year orbits. This means that astronomers need to wait a very long time to see how the planets move along their paths. The added time span from the Hubble data helps enormously. "The archive got us 10 years of science right now," he says. "Without this data we would have had to wait another decade. It's 10 years of science for free."

Nevertheless, the slowest-moving, outermost planet has barely changed position in 10 years. "But if we go to the next inner planet we see a little bit of an orbit, and the third inner planet we actually see a lot of motion," says Soummer.

The planets weren't found in 1998 when the Hubble observations were first taken because the methods used to detect them were not available at that time. When astronomers subtracted the light from the central star to look for the residual glow of planets, the residual light scatter was still overwhelming the faint planets.

Lafreniere developed a way to improve this type of analysis by using a library of reference stars to more precisely remove the "fingerprint" glow of the central star. Soummer's team took Lafreniere's method a step further and used 466 images of reference stars taken from a library containing over 10 years of NICMOS observations assembled by Glenn Schneider of the University of Arizona.

Soummer's team further increased contrast and minimized residual starlight. They completely removed the diffraction spikes, which are artifacts common to telescope imaging systems. This allowed them to see two of the faint inner planets in the Hubble data. The planets recovered in the NICMOS data are about 1/100,000th the brightness of the parent star when viewed in near-infrared light.

Soummer next plans to analyze approximately 400 other stars in the NICMOS archive with the same technique, improving image quality by a factor of 10 over the imaging methods used when the data were obtained.

Soummer's work demonstrates the power of the Hubble Space Telescope data archive, which harbors images and spectral information from over twenty years of Hubble observations. Astronomers tap into this library to complement new observations with a wealth of invaluable data already gathered, yielding much more discovery potential than new observations alone.

From the NICMOS archive data Soummer's team will assemble a list of planetary candidates to be confirmed by ground-based telescopes. If new planets are discovered they will once again have several years' worth of orbital motion to measure.

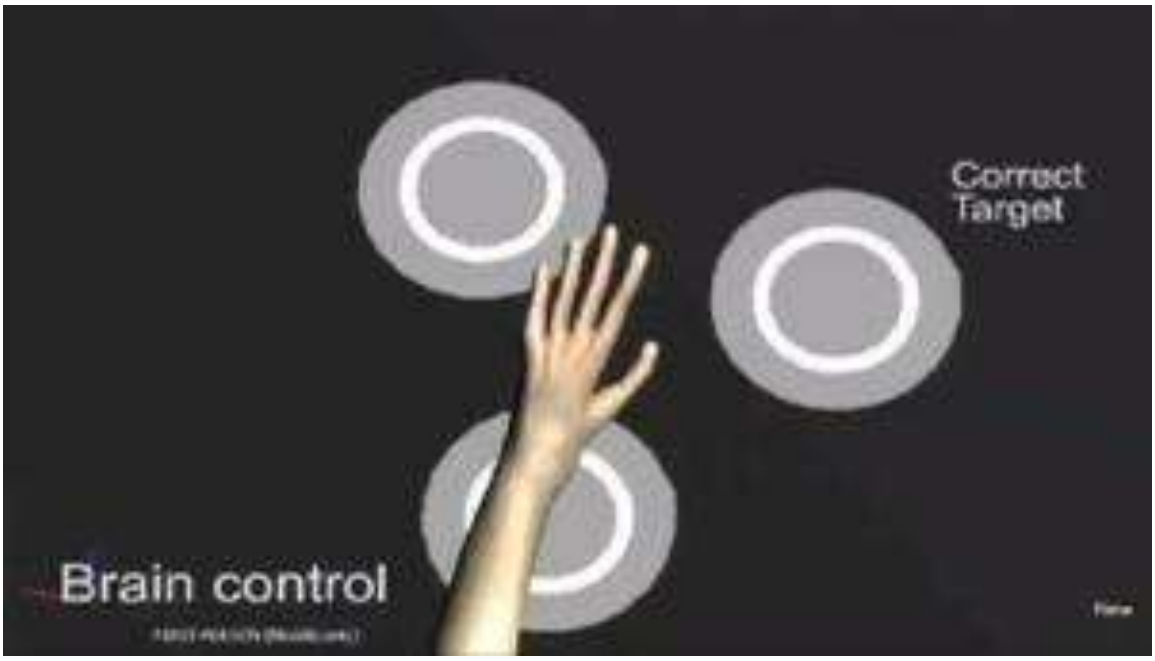
The Hubble Space Telescope is a project of international cooperation between NASA and the European Space Agency. NASA's Goddard Space Flight Center manages the telescope. The Space Telescope Science Institute (STScI) conducts Hubble science operations. STScI is operated for NASA by the Association of Universities for Research in Astronomy, Inc., in Washington, D.C.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **NASA/Goddard Space Flight Center**.

http://www.sciencedaily.com/releases/2011/10/111006173612.htm

Monkeys 'Move and Feel' Virtual Objects Using Only Their Brains



Without moving any part of their real bodies, the monkeys used their electrical brain activity to direct the virtual hands of an avatar to the surface of virtual objects and, upon contact, were able to differentiate their textures. (Credit: Image courtesy of Duke Center for Neuroengineering)

ScienceDaily (Oct. 6, 2011) — In a first ever demonstration of a two-way interaction between a primate brain and a virtual body, two monkeys trained at the Duke University Center for Neuroengineering learned to employ brain activity alone to move an avatar hand and identify the texture of virtual objects.

"Someday in the near future, quadriplegic patients will take advantage of this technology not only to move their arms and hands and to walk again, but also to sense the texture of objects placed in their hands, or experience the nuances of the terrain on which they stroll with the help of a wearable robotic exoskeleton," said Miguel Nicolelis, M.D., Ph.D., professor of neurobiology at Duke University Medical Center and co-director of the Duke Center for Neuroengineering, who was senior author of the study.

Without moving any part of their real bodies, the monkeys used their electrical brain activity to direct the virtual hands of an avatar to the surface of virtual objects and, upon contact, were able to differentiate their textures.

Although the virtual objects employed in this study were visually identical, they were designed to have different artificial textures that could only be detected if the animals explored them with virtual hands controlled directly by their brain's electrical activity.

The texture of the virtual objects was expressed as a pattern of minute electrical signals transmitted to the monkeys' brains. Three different electrical patterns corresponded to each of three different object textures.

Because no part of the animal's real body was involved in the operation of this brain-machine-brain interface (BMBI), these experiments suggest that in the future patients severely paralyzed due to a spinal cord lesion may take advantage of this technology, not only to regain mobility, but also to have their sense of touch restored, said Nicolelis, who was senior author of the study published in the journal *Nature* on Oct. 5.

"This is the first demonstration of a brain-machine-brain interface that establishes a direct, bidirectional link between a brain and a virtual body," Nicolelis said. "In this BMBI, the virtual body is controlled directly by the animal's brain activity, while its virtual hand generates tactile feedback information that is signaled via direct electrical microstimulation of another region of the animal's cortex."

"We hope that in the next few years this technology could help to restore a more autonomous life to many patients who are currently locked in without being able to move or experience any tactile sensation of the surrounding world," Nicolelis said.

"This is also the first time we've observed a brain controlling a virtual arm that explores objects while the brain simultaneously receives electrical feedback signals that describe the fine texture of objects 'touched' by the monkey's newly acquired virtual hand," Nicolelis said. "Such an interaction between the brain and a virtual avatar was totally independent of the animal's real body, because the animals did not move their real arms and hands, nor did they use their real skin to touch the objects and identify their texture. It's almost like creating a new sensory channel through which the brain can resume processing information that cannot reach it anymore through the real body and peripheral nerves."

The combined electrical activity of populations of 50-200 neurons in the monkey's motor cortex controlled the steering of the avatar arm, while thousands of neurons in the primary tactile cortex were simultaneously receiving continuous electrical feedback from the virtual hand's palm that let the monkey discriminate between objects, based on their texture alone.

"The remarkable success with non-human primates is what makes us believe that humans could accomplish the same task much more easily in the near future," Nicolelis said.

It took one monkey only four attempts and another nine attempts before they learned how to select the correct object during each trial. Several tests demonstrated that the monkeys were actually sensing the object and not selecting them randomly.

The findings provide further evidence that it may be possible to create a robotic exoskeleton that severely paralyzed patients could wear in order to explore and receive feedback from the outside world, Nicolelis said. Such an exoskeleton would be directly controlled by the patient's voluntary brain activity in order to allow the patient to move autonomously. Simultaneously, sensors distributed across the exoskeleton would generate the type of tactile feedback needed for the patient's brain to identify the texture, shape and temperature of objects, as well as many features of the surface upon which they walk.

This overall therapeutic approach is the one chosen by the Walk Again Project, an international, non-profit consortium, established by a team of Brazilian, American, Swiss, and German scientists, which aims at restoring full body mobility to quadriplegic patients through a brain-machine-brain interface implemented in conjunction with a full-body robotic exoskeleton.

The international scientific team recently proposed to carry out its first public demonstration of such an autonomous exoskeleton during the opening game of the 2014 FIFA Soccer World Cup that will be held in Brazil.

Other authors include Joseph E. O'Doherty, Mikhail A. Lebedev, Peter J. Ifft, Katie Z. Zhuang, all from the Duke University Center for Neuroengineering and Solaiman Shokur, and Hannes Bleuler from the Ecole Polytechnic Federale de Lausanne (EPFL), in Lausanne, Switzerland.

This work was funded by the U.S. National Institutes of Health.

A video illustrating the experiment is available at: http://www.youtube.com/watch?v=WTTTwvjCa5g

Story Source:

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

Journal Reference:

1. Joseph E. O'Doherty, Mikhail A. Lebedev, Peter J. Ifft, Katie Z. Zhuang, Solaiman Shokur, Hannes Bleuler, Miguel A. L. Nicolelis. **Active tactile exploration using a brain–machine–brain interface**. *Nature*, 2011; DOI: 10.1038/nature10489

http://www.sciencedaily.com/releases/2011/10/111005131648.htm

Shockingly Orange, Invitingly Meandering, Immensely Imposing

By KAREN ROSENBERG

At 71 the indefatigable sculptor Richard Serra is making some of the most intensely visceral work of his career. His latest sculptures in weatherproof steel are big enough to test the boundaries of the immense Gagosian Gallery on 24th Street in Chelsea, though their power has less to do with their sheer magnitude than with the way they carve up the space.

The show is Mr. Serra's 12th sculpture exhibition at Gagosian, and his best in New York since a 2007 retrospective at MoMA. A touring survey of his drawings, organized by the Menil Collection and seen at the Metropolitan Museum this past summer, opens next month at the San Francisco Museum of Modern Art.

His ponderous way with black oil paintstick isn't much in evidence here, except for a single drawing installed in the front window. Nor are the rectangular slabs from his 2006 exhibition at Gagosian, or the boat-shaped labyrinths shown at the gallery's 21st Street location in 2009.

Rather, this show, titled "Junction/Cycle" after its two main components, revisits the graceful spirals and ellipses Mr. Serra exhibited here around 2001. Looking at the new work, I felt Mr. Serra, like the rest of us, thinking back to that year.

But he's also pushing forward, finding new ways to make one of Chelsea's biggest galleries feel intimate and even claustrophobic with his giant, snaking swaths of steel. He is perhaps the only artist who is capable of doing so.

The two sculptures at Gagosian almost fill the rooms that house them. "Cycle" measures 57 feet at its longest point, "Junction" 75 feet; they are 14 and 13 feet high, with "Cycle" nearly brushing the front gallery's ceiling trusses. Together they weigh 441 tons. Yet they're nimble, exquisitely responsive to each other and the space around them.

"Cycle," when seen in an overhead photograph, looks like a loosely-wound Celtic triple-spiral. "Junction" has four curved arms that branch out from a central node. But I recommend consulting these images only after you've walked through the sculptures, so that you are effectively mapless.

This is important because the works are essentially mazes. In a rare move Mr. Serra is giving you options. There are many ways through the sculptures, some of them more circuitous than others but all of them equally valid.

The first piece you will encounter is "Cycle," just past the reception desk. Almost immediately upon slipping into its metallic embrace you are forced to make a choice. One path dead-ends, leaving you in an elliptical enclosure; the other leads you along a slim, winding channel where you will be presented with more choices.

It's as if Mr. Serra had deconstructed one of his "Torqued Ellipses," turning a single journey to the center into two discrete experiences. This accounts, partly, for the sensation of time splitting.

Fellow travelers, muttering, "Left or right?" or "Did we walk this way? I think so," appear and reappear. Eventually you'll emerge into a corner of the gallery, feeling thoroughly discombobulated.

The entire passage brings to mind a hike through a redwood forest, especially when the ruddy ribbons of weathered steel nearly converge overhead. It can be very dark in there, and lush; even though you can hear the buzz of fluorescent light fixtures, they seem to be miles away. Mr. Serra would probably resist being called a landscape artist, but "Cycle" has more than a touch of the sublime.

"Junction," the second and more expansive sculpture, reinforces that notion with great, velvety sweeps of metal that have been patinated to a rich pumpkin hue. The color is unexpected; apparently the sandblasted steel has only begun to oxidize, so it looks lighter and brighter than the material in Mr. Serra's last couple of shows. In places you can see a leaf pattern where tree branches brushed the steel plates as they were en route to the gallery; they had been loaded onto trailers but were delayed by Hurricane Irene.

Once you're between those plates, you feel a tremendous surge. "Cycle" offers clearings, where you can pause and collect yourself. But the blind curves of "Junction" propel you through and, before you know it, spit you out. The movement feels akin to surfing, or being whooshed through a system of pneumatic tubes.

The relationship between the two sculptures is endlessly fascinating. You might see "Cycle" as a contracted version of "Junction," a figure skater in spin mode. Or you might see "Junction" as the extrovert to "Cycle's" introvert, with its four arcs that open wide to face the gallery walls.

Either way, you'll start to see around, under and behind the tons of steel that went into these works, to understand what Mr. Serra means when he says, "I consider space to be my primary material."

"Junction/Cycle" continues through Nov. 26 at Gagosian Gallery, 555 West 24th Street, Chelsea; (212) 741-1111, gagosian.com.

http://www.nytimes.com/2011/10/06/arts/design/richard-serras-sculpture-at-gagosian-gallery-review.html?ref=design

Patient-Specific Stem Cells: Major Step Toward Cell-Based Therapies for Life-Threatening Diseases

For the first time, scientists have derived embryonic stem cells from individual patients by adding the nuclei of adult skin cells from patients with type 1 diabetes to unfertilized donor oocytes (Credit: © Chee-Onn Leong / Fotolia)

ScienceDaily (Oct. 6, 2011) — A team of scientists led by Dieter Egli and Scott Noggle at The New York Stem Cell Foundation (NYSCF) Laboratory in New York City has made an important advance in the development of patient-specific stem cells that could impact the study and treatment of diseases such as diabetes, Parkinson's, and Alzheimer's.

As reported in the journal *Nature*, for the first time the scientists have derived embryonic stem cells from individual patients by adding the nuclei of adult skin cells from patients with type 1 diabetes to unfertilized donor oocytes.

The achievement is significant because such patient-specific cells potentially can be transplanted to replace damaged or diseased cells in persons with diabetes and other diseases without rejection by the patient's immune system. The scientists report further work is necessary before such cells can be used in cell-replacement medicine.

The research was conducted in The NYSCF Laboratory in Manhattan in collaboration with clinicians and researchers at Columbia University Medical Center. DNA analysis was provided by scientists at the University of California, San Diego.

"The specialized cells of the adult human body have an insufficient ability to regenerate missing or damaged cells caused by many diseases and injuries," said Dr. Egli, NYSCF senior scientist in the study. "But if we can reprogram cells to a pluripotent state, they can give rise to the very cell types affected by disease, providing great potential to effectively treat and even cure these diseases. In this three-year study, we successfully

reprogrammed skin cells to the pluripotent state. Our hope is that we can eventually overcome the remaining hurdles and use patient-specific stem cells to treat and cure people who have diabetes and other diseases."

"The ultimate goal of this study is to save and enhance lives by finding better treatments and eventually cures for diabetes, Alzheimer's, Parkinson's and other debilitating diseases and injuries affecting millions of people across the US and the globe," said NYSCF CEO Susan L. Solomon. "This research brings us an important step closer to creating new healthy cells for patients to replace their cells that are damaged or lost through injury."

The scientists demonstrate for the first time that the transfer of the nucleus from an adult skin cell of a patient into an oocyte without removing the oocyte nucleus results in reprogramming of the adult nucleus to the pluripotent state. Embryonic stem cell lines were then derived from the oocyte containing the patient's genetic material.

Since these pluripotent stem cells also have a copy of the chromosome from the oocyte, resulting in an abnormal number of chromosomes, these cells are not ready for therapeutic use. Future work will focus on understanding the role of the oocyte chromosome so that patient- specific stem cells can be made that contain only the patient's DNA.

In the study, skin cells from patients with type 1 diabetes and healthy patients (control group) were reprogrammed, allowing the derivation of pluripotent stem cells, cells that have the capacity for universal tissue production. Such cells potentially could be used to create beta cells that produce insulin.

Patients with type 1 diabetes lack insulin-producing beta cells, resulting in insulin deficiency and high blood sugar levels. Producing beta cells from stem cells for transplantation holds promise for the treatment and potential cure of type 1 diabetes.

"This is an important step toward generating stem cells for disease modeling and drug discovery, as well as for ultimately creating patient-specific cell-replacement therapies for people with diabetes or other degenerative diseases or injuries," said Rudolph L. Leibel, MD, co-director of Columbia's Naomi Berrie Diabetes Center and a collaborator in the study.

The study raises the possibility of using somatic cell reprogramming to create banks of stem cells that could be used for a wide range of patients, noted another collaborator, Robin Goland, MD, co-director of the Naomi Berrie Diabetes Center. "In theory, stem cell lines could be matched to a particular patient, much as we do now when we screen an individual for compatibility with a kidney transplant," she said.

"This project is a great example of how enormous strides can be achieved when investigators in basic science and clinical medicine collaborate," said Mark V. Sauer, MD, a coauthor of the paper and Vice Chairman of the Department of Obstetrics and Gynecology and chief of reproductive endocrinology at Columbia University Medical Center. Dr. Sauer is also program director of assisted reproduction at the Center for Women's Reproductive Care. "I feel fortunate to have been able to participate in this important project."

Zach W. Hall, PhD, former Director of the NIH's National Institute of Neurological Disorders and Stroke and former President of the California Institute for Regenerative Medicine said, "This work represents a major advance toward the production of patient-specific stem cells for therapeutic use by demonstrating that the nucleated oocyte has the ability to completely reprogram the nucleus of an adult human cell."

The study was funded solely with private funding and adhered to ethical guidelines adopted by the American Society for Reproductive Medicine and the International Society for Stem Cell Research, as well as protocols reviewed and approved by the institutional review board and stem cell committees of Columbia University.

Story Source:

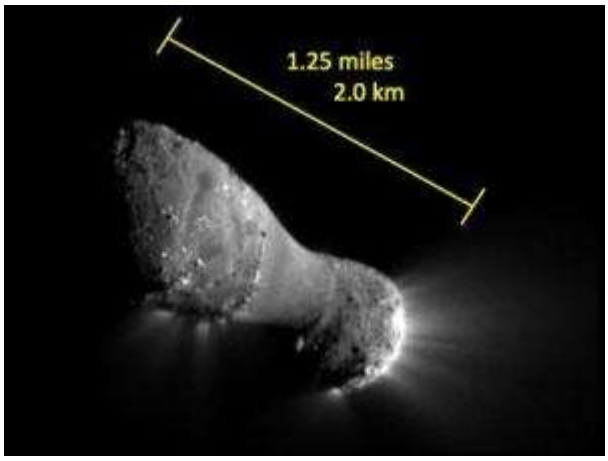
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **New York Stem Cell Foundation**.

Journal Reference:

1. Scott Noggle, Ho-Lim Fung, Athurva Gore, Hector Martinez, Kathleen Crumm Satriani, Robert Prosser, Kiboong Oum, Daniel Paull, Sarah Druckenmiller, Matthew Freeby, Ellen Greenberg, Kun Zhang, Robin Goland, Mark V. Sauer, Rudolph L. Leibel, Dieter Egli. **Human oocytes reprogram somatic cells to a pluripotent state**. *Nature*, 2011; 478 (7367): 70 DOI: 10.1038/nature10397

http://www.sciencedaily.com/releases/2011/10/111006090029.htm

First Comet Found With Ocean-Like Water



This is the comet Hartley, as imaged by NASA's EPOXI spacecraft. (Credit: Image courtesy of NASA)

ScienceDaily (Oct. 6, 2011) — New evidence supports the theory that comets delivered a significant portion of Earth's oceans, which scientists believe formed about 8 million years after the planet itself.

The findings, which involve a University of Michigan astronomer, are published Oct. 5 online in *Nature*.

"Life would not exist on Earth without liquid water, and so the questions of how and when the oceans got here is a fundamental one," said U-M astronomy professor Ted Bergin, "It's a big puzzle and these new findings are an important piece."

Bergin is a co-investigator on HiFi, the Heterodyne Instrument for the Infrared on the Hershel Space Observatory. With measurements from HiFi, the researchers found that the ice on a comet called Hartley 2 has the same chemical composition as our oceans. Both have similar D/H ratios. The D/H ratio is the proportion of deuterium, or heavy hydrogen, in the water. A deuterium atom is a hydrogen with an extra neutron in its nucleus.

This was the first time ocean-like water was detected in a comet.

"We were all surprised," Bergin said.

Six other comets HiFi measured in recent years had a much different D/H ratio than our oceans, meaning similar comets could not have been responsible for more than 10 percent of Earth's water.

The astronomers hypothesize that Hartley 2 was born in a different part of the solar system than the other six. Hartley most likely formed in the Kuiper belt, which starts near Pluto at about 30 times farther from the sun than Earth is. The other six hail from the Oort Cloud more than 5,000 times farther out.

The source of earth's oceans has been a subject for debate among astronomers for decades. Until now, asteroids were thought to have provided most of the water. Now, however, Herschel has shown that at least one comet does have ocean-like water.

"The results show that the amount of material out there that could have contributed to Earth's oceans is perhaps larger than we thought," Bergin said.

Herschel, a European Space Agency mission with NASA participation, is an orbiting telescope that allows astronomers to observe at the far-infrared wavelengths where organic molecules and water emit their chemical signatures.

Story Source:

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

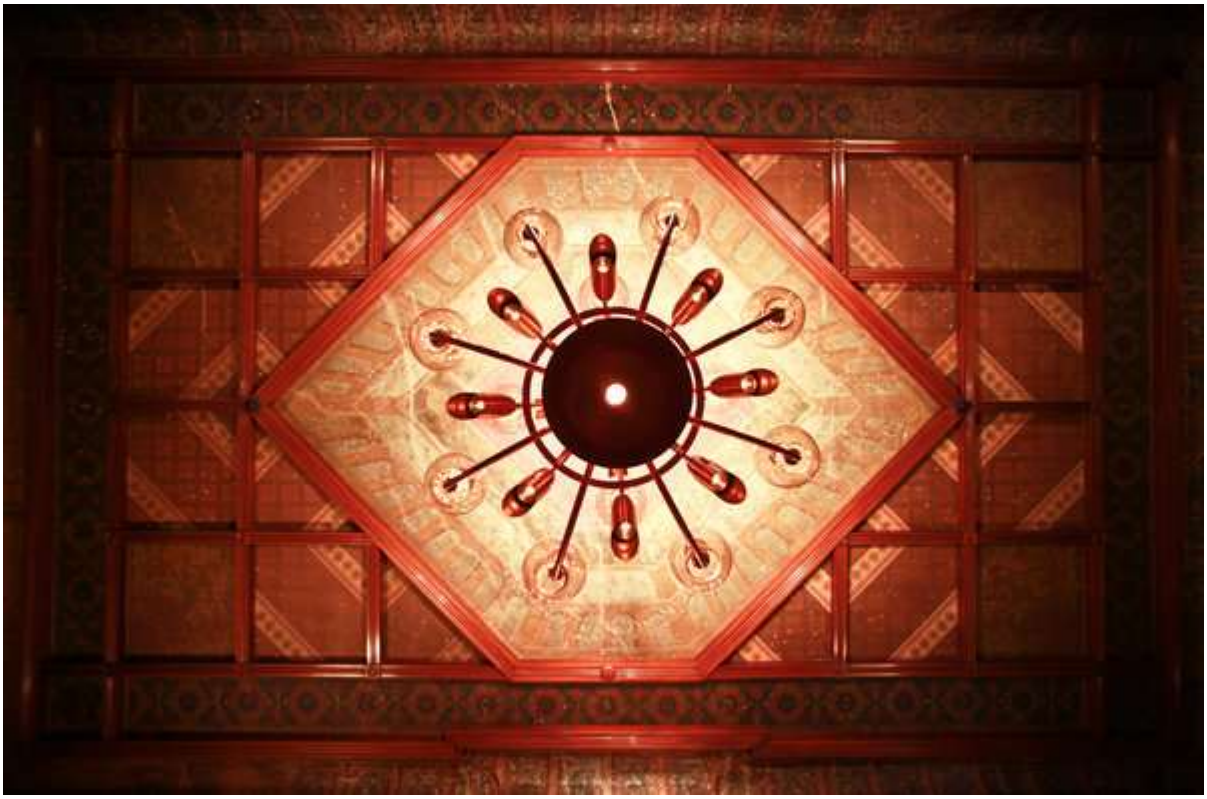
Journal Reference:

1. Paul Hartogh, Dariusz C. Lis, Dominique Bockelée-Morvan, Miguel de Val-Borro, Nicolas Biver, Michael Küppers, Martin Emprechtinger, Edwin A. Bergin, Jacques Crovisier, Miriam Rengel, Raphael Moreno, Slawomira Szutowicz, Geoffrey A. Blake. **Ocean-like water in the Jupiter-family comet 103P/Hartley 2**. *Nature*, 2011; DOI: 10.1038/nature10519

http://www.sciencedaily.com/releases/2011/10/111005131654.htm

Fixer-Upper With Unique Challenge

By ROBIN POGREBIN



Their work has been transformative and widely celebrated, as when they turned a former power station into the acclaimed Tate Modern in London in 2000.

So why would the prizewinning Swiss architects Jacques Herzog and Pierre de Meuron take on the Park Avenue Armory, a project that is more restoration than renovation, more fixer-upper than fresh take?

Wouldn't their sense of creative license be inhibited by the wood-paneled period rooms originally designed by the likes of Louis Comfort Tiffany and Stanford White? Wouldn't they yearn to break free of the building's 19th-century confines by inserting their own contemporary vision?

On the contrary, Mr. Herzog said in a recent interview, the armory presented a compelling architectural challenge. Rather than transform it, he said, the architects would use the building to explore the very act of transformation, the evolution of an important structure as it is seen and used and worn down by one generation after another.

"What is time?" Mr. Herzog said. "What is history? What are the materials? These things are involved in such a project.

"We wanted time and the layers of the time to be visible," he continued. "It's not so perfect."

As a result, the design for the new armory — unveiled on Wednesday — represents not so much an act of creation but a process of excavation: peeling back the layers of paint, plaster and wallpaper that have built up

since the building was completed in 1881; burnishing the chandeliers; and in some cases adding new fixtures and other elements like copper chain-link curtains to reduce the glare.

Built as a military site and social club by New York State's Seventh Regiment of the National Guard — the first volunteer militia to respond to Lincoln's call for troops in 1861 — the armory has been best known as home to the Winter Antiques Show. The building became a cultural center in 2007, when the nonprofit Seventh Regiment Armory Conservancy formally acquired it from the state under a 99-year lease.

The conservancy has used the building's cavernous Drill Hall to advantage in its programming, which has included Royal Shakespeare Company performances on a replica of the company's stage and art installations like Christian Boltanski's "No Man's Land," featuring a crane and a mound of salvaged clothing. In addition the building houses a homeless shelter, which will remain. The $200-million restoration is expected to be completed by 2015.

"You can't say the building is this and only this," Mr. Herzog said. "So many lives and ideas have been expressed there.

"If you renovate, where do you go back to? There is no particular point in history. History is a process. We believe every time and every contribution has its importance, versus something that freezes one moment in time."

In some places the architects have left evidence of what came before even as the rooms — two of which have been completed — clearly have been renewed. "If we could get to the original layer, we always went there," said Ascan Mergenthaler, a senior partner at the architecture firm. "We left traces and some interventions we couldn't remove. It's really this meticulous surgery."

Rather than large architectural flourishes the project has been distinguished by painstaking detail: researching the extensive photographs and documentation about the building, sending paint samples to a lab in Washington for analysis. One room alone was cleaned with 280,000 Q-tips.

"They have worked at the most exquisite level of detail," said Rebecca Robertson, the armory's president and executive producer. "Every move is small and subtle, but there are so many of them."

The architects have become known for transforming existing structures, though they also have designed many new buildings, like the expanded Walker Art Center in Minneapolis and the Parrish Art Museum in Southampton, N.Y.

"The way we understand architecture is not just doing one new building after another, but investigating the role of architecture today," Mr. Herzog said. "To deal with existing buildings is an interesting challenge. What has ultimately been described as presentation is much more complex: how to deal with something that is here."

In addition to the 18 period rooms at the armory, the architects have applied their understated approach to the building's signature Drill Hall, a 55,000-square-foot airplane hangar of a space. There will be no drastic, visible changes. Instead, the architects are shoring up the infrastructure, installing production equipment and stabilizing balconies for seating, cables, exhibitions and circulation.

"The emptiness is the great potential and also the flexibility this emptiness offers," Mr. Herzog said. "Any intervention would not be necessary. We don't want to turn this into a ridiculous version of itself."

The space will remain unobstructed, so that artists can define it. “The relation of the audience members to the art can be anything it wants,” Ms. Robertson said. “You can be walking through the art, you can be looking down on the art.”

Over all the armory retains its aura of frayed grandeur, a quality the architects strived to maintain, even as they refreshed the building that had suffered from water damage and years of neglect. “All the scars are visible,” Mr. Mergenthaler said, “but they don’t dominate.”

That’s how the armory’s administration wanted it. “Part of the mandate to them was: We didn’t want to lose the soul of the building,” Ms. Robertson said.

The architects recognize that the armory as an exhibition space is a far cry from conventional “white cube” galleries, or what Mr. Herzog called “egocentric, architecturally driven museums.” But he said the spaces are likely to inspire artists, not limit them. “Artists have increasingly started to like strange places to put their art,” he said. “The specific conditions are unique and interesting and every artist is challenged to put his paintings or performances in such historic conditions.”

The project remains very much a work in progress. Still unresolved are questions like whether to keep the entrance staircase wood dark or to restore its original honey-color glow. “I’m undecided, I must say,” Mr. Herzog said. “We don’t have the answers yet for every corner.”

http://www.nytimes.com/2011/10/06/arts/design/park-avenue-armory-to-get-swiss-makeover.html?_r=1&ref=design

Triple Rainbows Exist, Photo Evidence Shows

Top: (a) Original image of a third-order (tertiary) rainbow. The image was taken May 15, 2011, in Kampfelbach, Germany and is the first-ever picture of a tertiary rainbow. Two reference positions (A and B) for image orientation are indicated. (b) Processed version of image (a) after contrast expansion and unsharp masking, showing a rainbow-like pattern next to the image center, marked by the arrows. Bottom: The third-order (tertiary) rainbow (left), accompanied by the fourth-order (quaternary) rainbow (right). They appear on the sunward side of the sky, at approximately 40° and 45°, respectively, from the Sun. This is the first picture ever of a quaternary rainbow in nature and the second picture ever of a tertiary rainbow. (Credit: Top: Michael Grossmann/Applied Optics; Bottom: Michael Theusner/Applied Optics)

ScienceDaily (Oct. 6, 2011) — Few people have ever claimed to see three rainbows arcing through the sky at once. In fact, scientific reports of these phenomena, called tertiary rainbows, were so rare -- only five in 250 years -- that until now many scientists believed sightings were as fanciful as Leprechaun's gold at a rainbow's end. These legendary optical rarities, caused by three reflections of each light ray within a raindrop, have finally been confirmed, thanks to photographic perseverance and a new meteorological model that provides the scientific underpinnings to find them.

The work is described in a series of papers in a special issue published this week in the Optical Society's (OSA) journalApplied Optics.

In addition to the confirmed photo of a tertiary rainbow, the optical treasure hunt went one step further, as revealed in another photo that shows the shimmering trace of a fourth (quaternary) rainbow.

Raymond Lee, a professor of meteorology at the U.S. Naval Academy, did not snap those pictures, but he did make them possible. One year ago, Lee predicted how tertiary rainbows might appear and challenged rainbow chasers to find them.

Although staggeringly rare, tertiary and quaternary rainbows are natural products of the combination of refraction, dispersion, and reflection inside raindrops. These are the same processes that create all rainbows, yet they are taken to their most extreme to produce these higher order variants. Refraction is when sunlight bends as it moves from air into water and vice versa. (Such bending makes oars look bent when partially submerged.) Water droplets bend each of the colors in sunlight by a slightly different angle. This is called dispersion, and it separates the colors to create a rainbow.

Most of that multicolored light passes through the other side of the raindrop, but some is reflected. The raindrop's spherical curves concentrate those reflections at 138 degrees from the Sun. This concentrated light is bright enough to create a visible primary rainbow.

A double rainbow occurs because not all that light exits the raindrop. Some is reflected back into the raindrop and goes through the whole process again. Although this light is dimmer, sometimes it is bright enough to produce a secondary rainbow just outside the first.

A third series of reflections creates a tertiary rainbow. It is even dimmer than the secondary rainbow, and much harder to find because instead of forming away from the Sun, a tertiary rainbow forms around the Sun. To see it, observers have to look into the Sun's glare.

This may be why only five scientifically knowledgeable observers had described tertiary rainbows during the past 250 years.

Lee reviewed each description. He eliminated one questionable account and found common elements in the others. All described tertiary rainbows that appeared for a few seconds against a dark background of clouds about 40 degrees from a brightly shining sun.

Along with colleague Philip Laven, Lee used a mathematical model to predict what conditions might produce visible tertiaries. First, they needed dark thunderclouds and either a heavy downpour or a rainstorm with nearly uniformly sized droplets. Under these conditions, if the Sun broke through the clouds, it could project a tertiary rainbow against the dark clouds nearby. The contrasting colors would make the dim tertiary visible.

When Lee presented his findings at last year's International Conference on Atmospheric Optics, it sparked heated discussion. Some scientists insisted that past descriptions were wrong and that tertiaries were too dim to see in the Sun's glare.

One attendee, Elmar Schmidt, an astronomer at Germany's SRH University of Applied Sciences in Heidelberg and a rainbow chaser, took the guidelines as a challenge. He alerted likeminded amateurs. Since then, Michael Grossmann and Michael Theusner have snapped photos of tertiary rainbows. One photo even shows a quaternary rainbow, and both images, which underwent only minimal image processing to improve the contrast under these challenging photographic conditions, appear in the same *Applied Optics* special issue as Lee and Laven's paper.

The day Grossmann photographed the tertiary rainbow, he first recalled seeing a double rainbow. When the rain intensified, he knew he had to turn toward the Sun. "It is really exaggerated to say that I saw it, but there seemed to be something," he says. The pictures he snapped in the rain were the first to show a tertiary rainbow.

Of the noteworthy discovery, "it was as exciting as finding a new species," Lee says.

Story Source:

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

Journal References:

1. Raymond L. Lee, Jr., Philip Laven. **Visibility of natural tertiary rainbows**. *Applied Optics*, 2011; 50 (28): F152 DOI: 10.1364/AO.50.00F152
2. Michael Großmann, Elmar Schmidt, Alexander Haußmann. **Photographic evidence for the third-order rainbow**. *Applied Optics*, 2011; 50 (28): F134 DOI: 10.1364/AO.50.00F134
3. Michael Theusner. **Photographic observation of a natural fourth-order rainbow**. *Applied Optics*, 2011; 50 (28): F129 DOI: 10.1364/AO.50.00F129

http://www.sciencedaily.com/releases/2011/10/111005111001.htm

Biologists Find 'Surprising' Number of Unknown Viruses in Sewage

Raw sewage is home to thousands of novel, undiscovered viruses, some of which could relate to human health, researchers report in a new paper. (Credit: © Dmitry Vereshchagin / Fotolia)

ScienceDaily (Oct. 6, 2011) — Though viruses are the most abundant life form on Earth, our knowledge of the viral universe is limited to a tiny fraction of the viruses that likely exist. In a paper published in the online journal *mBio*, researchers from the University of Pittsburgh, Washington University in St. Louis, and the University of Barcelona found that raw sewage is home to thousands of novel, undiscovered viruses, some of which could relate to human health.

There are roughly 1.8 million species of organisms on our planet, and each one is host to untold numbers of unique viruses, but only about 3,000 have been identified to date. To explore this diversity and to better characterize the unknown viruses, Professor James Pipas, Distinguished Professor of Biological Sciences Roger Hendrix, and Assistant Professor Michael Grabe, all of the Department of Biological Sciences in Pitt's Kenneth P. Dietrich School of Arts and Sciences, are developing new techniques to look for novel viruses in unique places around the world.

With coauthors David Wang and Guoyan Zhao of Washington University in St. Louis and Rosina Girones of the University of Barcelona, the team searched for the genetic signatures of viruses present in raw sewage from North America, Europe, and Africa.

In the paper, titled "Raw Sewage Harbors Diverse Viral Populations," the researchers report detecting signatures from 234 known viruses that represent 26 different families of viruses. This makes raw sewage home to the most diverse array of viruses yet found.

"What was surprising was that the vast majority of viruses we found were viruses that had not been detected or described before," says Hendrix.

The viruses that were already known included human pathogens like *Human papillomavirus* and norovirus, which causes diarrhea. Also present were several viruses belonging to those familiar denizens of sewers everywhere: rodents and cockroaches. Bacteria are also present in sewage, so it was not surprising that the viruses that prey on bacteria dominated the known genetic signatures. Finally, a large number of the known viruses found in raw sewage came from plants, probably owing to the fact that humans eat plants, and plant viruses outnumber other types of viruses in human stool.

This study was also the first attempt to look at all the viruses in the population. Other studies have focused on bacteria, or certain types of viruses. The researchers also developed new computational tools to analyze this data. This approach, called metagenomics, had been done before, but not with raw sewage.

The main application of this new technology, says Hendrix, will be to discover new viruses and to study gene exchange among viruses. "The big question we're interested in is, 'Where do emerging viruses come from?'" he says. The team's hypothesis is that new viruses emerge, in large part, through gene exchange. But before research on gene exchange can begin in earnest, large numbers of viruses must be studied, the researchers say.

"First you have to see the forest before you can pick out a particular tree to work on," says Pipas. "If gene exchange is occurring among viruses, then we want to know where those genes are coming from, and if we only know about a small percentage of the viruses that exist, then we're missing most of the forest."

Story Source:

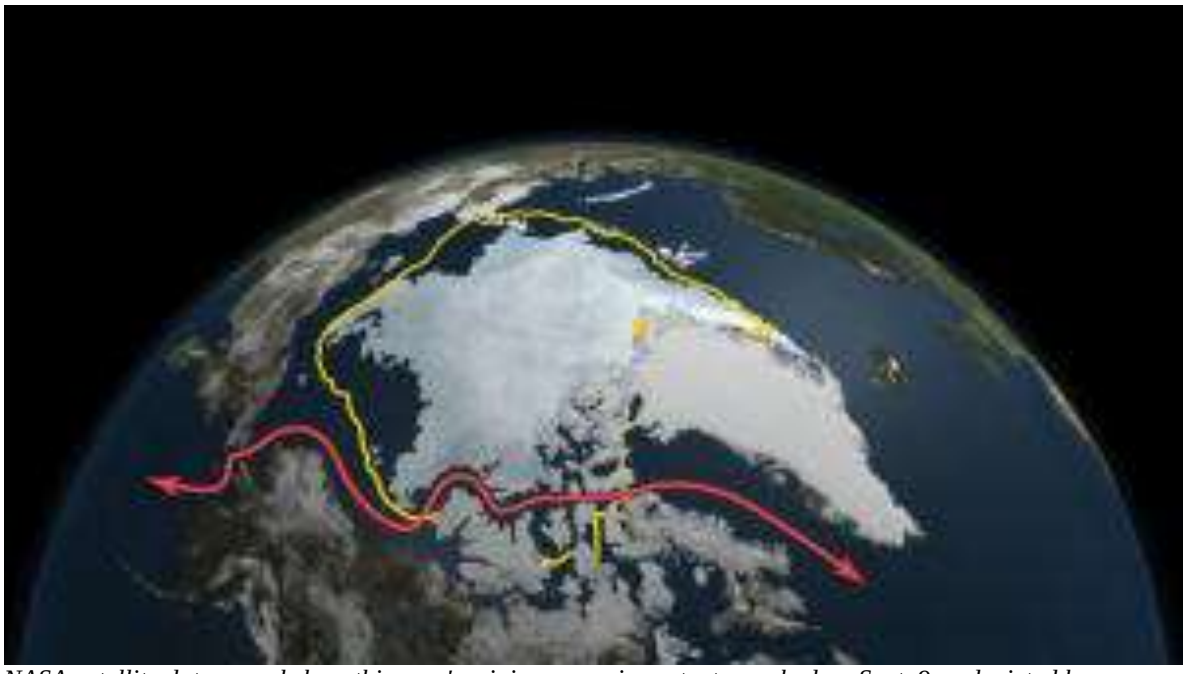
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Pittsburgh**.

Journal Reference:

1. P. G. Cantalupo, B. Calgua, G. Zhao, A. Hundesa, A. D. Wier, J. P. Katz, M. Grabe, R. W. Hendrix, R. Girones, D. Wang, J. M. Pipas. **Raw Sewage Harbors Diverse Viral Populations**. *mBio*, 2011; 2 (5): e00180-11 DOI: 10.1128/mBio.00180-11

http://www.sciencedaily.com/releases/2011/10/111005172651.htm

Arctic Sea Ice Continues Decline, Hits Second-Lowest Level



NASA satellite data reveals how this year's minimum sea ice extent, reached on Sept. 9 as depicted here, declined to a level far smaller than the 30-year average (in yellow) and opened up Northwest Passage shipping lanes (in red). (Credit: NASA Goddard's Scientific Visualization Studio)

ScienceDaily (Oct. 6, 2011) — Last month the extent of sea ice covering the Arctic Ocean declined to the second-lowest extent on record. Satellite data from NASA and the NASA-supported National Snow and Ice Data Center (NSIDC) at the University of Colorado in Boulder showed that the summertime sea ice cover narrowly avoided a new record low.

The Arctic ice cap grows each winter as the sun sets for several months and shrinks each summer as the sun rises higher in the northern sky. Each year the Arctic sea ice reaches its annual minimum extent in September. It hit a record low in 2007.

The near-record ice-melt followed higher-than-average summer temperatures, but without the unusual weather conditions that contributed to the extreme melt of 2007. "Atmospheric and oceanic conditions were not as conducive to ice loss this year, but the melt still neared 2007 levels," said NSIDC scientist Walt Meier. "This probably reflects loss of multiyear ice in the Beaufort and Chukchi seas as well as other factors that are making the ice more vulnerable."

Joey Comiso, senior scientist at NASA's Goddard Space Flight Center in Greenbelt, Md., said the continued low minimum sea ice levels fits into the large-scale decline pattern that scientists have watched unfold over the past three decades.

"The sea ice is not only declining, the pace of the decline is becoming more drastic," Comiso said. "The older, thicker ice is declining faster than the rest, making for a more vulnerable perennial ice cover."

While the sea ice extent did not dip below the 2007 record, the sea ice area as measured by the microwave radiometer on NASA's Aqua satellite did drop slightly lower than 2007 levels for about 10 days in early

September, Comiso said. Sea ice "area" differs from extent in that it equals the actual surface area covered by ice, while extent includes any area where ice covers at least 15 percent of the ocean.

Arctic sea ice extent on Sept. 9, the lowest point this year, was 4.33 million square kilometers (1.67 million square miles). Averaged over the month of September, ice extent was 4.61 million square kilometers (1.78 million square miles). This places 2011 as the second lowest ice extent both for the daily minimum extent and the monthly average. Ice extent was 2.43 million square kilometers (938,000 square miles) below the 1979 to 2000 average.

This summer's low ice extent continued the downward trend seen over the last 30 years, which scientists attribute largely to warming temperatures caused by climate change. Data show that Arctic sea ice has been declining both in extent and thickness. Since 1979, September Arctic sea ice extent has declined by 12 percent per decade.

"The oldest and thickest ice in the Arctic continues to decline, especially in the Beaufort Sea and the Canada Basin," NSIDC scientist Julienne Stroeve said. "This appears to be an important driver for the low sea ice conditions over the past few summers."

Climate models have suggested that the Arctic could lose almost all of its summer ice cover by 2100, but in recent years, ice extent has declined faster than the models predicted.

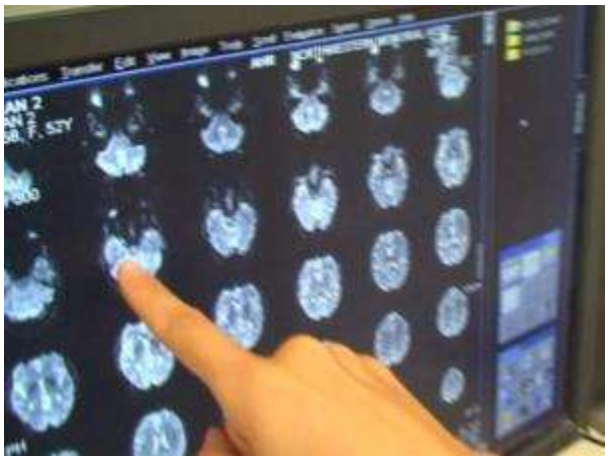
NASA monitors and studies changing sea ice conditions in both the Arctic and Antarctic with a variety of spaceborne and airborne research capabilities. This month NASA resumes Operation IceBridge, a multi-year series of flights over sea ice and ice sheets at both poles. This fall's campaign will be based out of Punta Arenas, Chile, and make flights over Antarctica. NASA also continues work toward launching ICESat-2 in 2016, which will continue its predecessor's crucial laser altimetry observations of ice cover from space.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **NASA/Goddard Space Flight Center**.

http://www.sciencedaily.com/releases/2011/10/111004150400.htm

Human Brain Smells What It Expects Rather Than What It Sniffs



The researchers used functional MRI techniques and cutting-edge, pattern-based analysis to identify the existence of predictive coding in the olfactory cortex of the brain, where the sense of smell is housed. (Credit: Image courtesy of Northwestern University)

ScienceDaily (Oct. 6, 2011) — In the moments before you "stop and smell the roses," it's likely your brain is already preparing your sensory system for that familiar floral smell. New research from Northwestern Medicine offers strong evidence that the brain uses predictive coding to generate "predictive templates" of specific smells -- setting up a mental expectation of a scent before it hits your nostrils.

Predictive coding is important because it provides animals -- in this case, humans -- with a behavioral advantage, in that they can react more quickly and more accurately to stimuli in the surrounding environment.

The study, published in the Oct. 6 issue of the journal *Neuron*, was led by Christina Zelano, a postdoctoral fellow in the lab of Jay Gottfried, M.D., associate professor of neurology at Northwestern University Feinberg School of Medicine and attending physician at Northwestern Memorial Hospital.

The researchers used functional MRI techniques and cutting-edge, pattern-based analysis to identify the existence of predictive coding in the olfactory cortex of the brain, where the sense of smell is housed.

While it may not be obvious that predictive templates in the olfactory system give modern-day humans a behavioral advantage, Zelano said people often overlook the power of the sense of smell.

"If somebody hands you a bottle of milk and asks, 'Is this milk rotten?' there may not be any visual clues to help you accurately determine if the milk has spoiled, so you rely on your sense of smell," Zelano said. "Our study indicated that if your brain can successfully form a template of a rotten milk smell, then you would more accurately determine whether that milk is rotten and therefore you are less likely to get sick. These predictive templates can give us an important advantage."

In the study, subjects performed "odor search tasks" while being monitored inside an MRI scanner. The two scents used in the study were a watermelon smell and a Play-Doh-like smell.

Before each trial began, subjects were told which of two target smells they should try to identify. A visual countdown, informing the subjects that they should get ready to receive a specific odor was administered and then, after smelling the odor, subjects indicated by pressing a button whether they thought the target smell

was present. Sometimes the target scent administered was the same as the subject was foretold, sometimes it was different, and sometimes the target scent was hidden in a mixture of other scents.

The researchers were able to look at the activity pattern of the brain before any odor arrived and found that, for trials where the target was the same, the activity pattern was more correlated than when the target was different.

"Our study confirmed the existence of predictive coding mechanisms in olfaction," said Gottfried, senior author of the study. "We found that the entirety of the olfactory cortex we looked at did form predictive templates that were very specific to the targeted smell. "

Predictive templates have been studied in the visual system, but this is the first study to examine the spatiotemporal evolution of activity patterns in the human olfactory cortex.

This study was supported by the National Institute on Deafness and Other Communication Disorders.

Story Source:

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

Journal Reference:

1. Christina Zelano, Aprajita Mohanty, Jay A. Gottfried. **Olfactory Predictive Codes and Stimulus Templates in Piriform Cortex**. *Neuron*, 2011; 72 (1): 178-187 DOI: 10.1016/j.neuron.2011.08.010

http://www.sciencedaily.com/releases/2011/10/111007103308.htm

Supersaturated Water Vapor in Martian Atmosphere

Water transport in the Martian atmosphere. (Credit: © ESA/AOES Medialab)

ScienceDaily (Oct. 6, 2011) — Analysis of data collected by the European Space Agency's Mars Express spacecraft leaves no room for doubt: the Martian atmosphere of contains water vapor in a supersaturated state. This surprising finding will enable scientists to better understand the water cycle on Mars, as well as the evolution of its atmosphere.

The research was led by a team from the Laboratoire Atmosphères, Milieux, Observations Spatiales (LATMOS, CNRS / UPMC / UVSQ), in collaboration with Russian and French colleagues(1), and received support from CNES. It is published in Sept. 30, 2011 issue of the journal *Science*.

On Earth, water vapor tends to condense, i.e. turn into a liquid, when the temperature falls below dew point. The atmosphere is said to be 'saturated' since it cannot hold any more moisture at that temperature and pressure. The excess water vapor then condenses around suspended particles and dust, forming precipitation. However, condensation may sometimes be much slower, especially when particles and dust are scarce. Unable to condense, the excess water vapor therefore remains in the gaseous state: this is known as supersaturation. Until now, it was assumed that this phenomenon could not occur in the Martian atmosphere, although this had never been proved.

While several spacecraft have visited Mars since the 1970s, most of their instruments were focused on surface data. Because of this, they only observed the horizontal component of the Martian atmosphere. The way in which water content on Mars varies with height remained largely unexplored. The survey carried out by the SPICAM(2) spectrometer on board the Mars Express spacecraft has now made it possible to fill this gap. SPICAM can establish vertical profiles of the atmosphere using solar occultation, i.e. by observing light from the Sun as it travels through the Martian atmosphere at sunrise and sunset.

Contrary to previous belief, the researchers discovered that water vapor supersaturation is a frequent phenomenon on Mars. They even observed very high levels of supersaturation in the Martian atmosphere, up to ten times greater than those found on Earth. "This ability of water vapor to exist in a highly supersaturated state would, for example, allow to supply the southern hemisphere of Mars with water, far more efficiently than models currently predict," points out Franck Montmessin, CNRS researcher at LATMOS and SPICAM(3) project leader. Moreover, a far greater quantity of water vapor than thought may be transported high enough in the atmosphere to be destroyed by photodissociation(4). If confirmed, this phenomenon would have consequences for the whole issue of Martian water, a significant fraction of which is known to have continually escaped to space for billions of years, which partly explains today's low abundance of water on the planet(5).

The vertical distribution of water vapor is key to the study of the hydrological cycle on Mars. The hypothesis according to which the amount of water in the Martian atmosphere is limited by the saturation process therefore needs revising. This finding has major implications for the current understanding of both the climate and water transport on Mars.

Notes:

1. François Forget, CNRS researcher at the Laboratoire de Météorologie Dynamique (LMD, CNRS/ENS Paris/UPMC/Ecole Polytechnique) took part in this work. Both his laboratory and LATMOS belong to the Institut Pierre-Simon Laplace.
2. This instrument is a dual ultraviolet and near infrared spectrometer, designed and produced by three laboratories (LATMOS, the Institut d'Aéronomie Spatiale in Brussels and the Space Research Institute (IKI) in Moscow), with funding from CNES.
3. Luca Maltagliati, the lead author of this study, received a CNES grant during his post-doctorate at LATMOS.
4. Solar radiation breaks up water molecules, releasing atoms of oxygen and hydrogen, which are then light enough to escape to interplanetary space.
5. On Earth, the amount of water is estimated to be equivalent to a 3 kilometer-deep layer of liquid water over the whole surface of the planet. Estimates for Mars are considerably lower, although little is known about the quantity of groundwater.

Story Source:

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

Journal Reference:

1. L. Maltagliati, F. Montmessin, A. Fedorova, O. Korablev, F. Forget, J.- L. Bertaux. **Evidence of Water Vapor in Excess of Saturation in the Atmosphere of Mars**. *Science*, 2011; 333 (6051): 1868 DOI: 10.1126/science.1207957

http://www.sciencedaily.com/releases/2011/10/111006113408.htm

Innovator of Dance Celebrates 40 Years

By FELICIA R. LEE

ROCHESTER — Garth Fagan does not simply walk into a room.

At 71 this ponytailed, Tony Award-winning choreographer of "The Lion King" moves as if he had wings on his shiny, green-trimmed black sneakers. On a recent warm day here at the downtown headquarters of Garth Fagan Dance he splashed into a high-ceilinged, bright studio to watch his troupe rehearse the work "Madiba," to be given its premiere on Tuesday at the Joyce Theater in New York. This is the first time Mr. Fagan has injected technology into his abstract choreography.

"O.K., darlings, here we go," he said, as the dancers twisted, thrust side to side, moved forward, jumped in the air and extended their legs.

"Madiba," a celebration of the life and ideas of Nelson Mandela, is signature Fagan: it has elements of modern and Afro-Caribbean dance as well as ballet, performed with elegant athleticism by dancers of varying body types. A piece of about 25 minutes, it includes a sensuous ballet-inflected duet and a modern version of a South African circle dance.

Norwood Pennewell, a longtime dancer with the company who portrays the Mandela figure, will have a small high-definition video camera attached to his head at times. It will allow him to film the other performers while he dances, with the images projected onto a screen.

Set to music of the South African jazz composer Abdullah Ibrahim, those images are meant to suggest Mr. Mandela's perspective and memories of friendships, love, incarceration, Mr. Fagan said. He expects the camera to work just fine, he said, but in case it does not, he has a Plan B: without it.

"It's a new direction for me," he said of the camera. "Madiba," he added, like much of his repertory, is focused on ideas and relationships and is decidedly nonautobiographical and nonnarrative. But he has

included a quotation from Mr. Mandela in the program to guide the way: “For to be free is not merely to cast off one’s chains, but to live in a way that reflects and enhances the freedom of others.”

Spending even a sliver of time with Mr. Fagan, who is talkative and easygoing, suggests that he too is taken with the notion of a more inclusive world. A great-grandfather who likes cooking, poetry, painting, music and collecting art, he rails against bias of any kind. One of his big dreams is to perform “Madiba” for Mr. Mandela, whom he has met several times and admires greatly.

“I want ‘Madiba’ to be an inspirational piece for survival, for change,” Mr. Fagan said in his mellifluous Jamaican accent. “I do not want this to be a documentary of his life. I’m interested in the strength, the perseverance, in uniting his country. That’s why I’m not naming people, and I’m calling it ‘Madiba,’ ” the name of Mr. Mandela’s clan.

“It’s a community of people,” Mr. Fagan added. “It’s more than one person.”

Mr. Fagan trained his attention on a duet in which a male dancer picked up a young female dancer, turned her upside down and they spin around. “This is a youthful romance from Mandela’s perspective,” Mr. Fagan said to a visitor. “Ladies, you can jump and have a man to catch you, and it’s O.K..”

“You seldom see black male-female relationships onstage that are warm and flirtatious,” he added.

“Madiba” is not the only new dance in his troupe’s Joyce run, from Tuesday through Sunday. Mr. Fagan is in the midst of a two-year celebration of the 40th anniversary of the founding of his company, and Mr. Pennewell, with the company for more than 30 years and the only other person to have choreographed for it, will introduce his “Liminal Flux,” set to music by Miles Davis and Chancha Via Circuito. Also in the mix will be “Thanks Forty,” Mr. Fagan’s tribute to the company’s history through many iterations, beginning with the teasing name the Bottom of the Bucket but ... Dance Theater in 1970.

The programs also reach back in time with “Translation Transition” from 2002, with a score from Jazz Jamaica All Stars (an exploration of traditional Jamaican music and jazz) and “Memoriam,” created in 2001 to honor the victims of the Sept. 11 attacks and their families.

Mr. Fagan, who has racked up a bouquet of awards over the years, has created nothing less than a new branch of modern dance, said Judith Jamison, the former dancer and for many years artistic director of the Alvin Ailey Dance Company.

“He’s not Eurocentric,” Ms. Jamison said. “It’s Caribbean, it’s polyrhythmic, it’s about sculpting space in a different way. He goes outside the boxes that are used, that dictate that we should look a certain way and move a certain way.”

Or, as Mr. Fagan says, he is jazz-influenced, sometimes moving his dancers with the music, sometimes against it.

His work manages to combine a “rich physicality and deeply human context,” said Virginia Johnson, the artistic director of the Dance Theater of Harlem.

This 40th anniversary is also a time for new work, culminating in a collaboration with Mr. Fagan’s close friend the composer and trumpeter Wynton Marsalis at the Brooklyn Academy of Music next September. It comes two decades after his first collaboration with Mr. Marsalis, “Griot New York,” a project Mr. Fagan called one of the “great blessings” of his life.

He and Mr. Marsalis cooked up "Griot," with a set that included pieces by the sculptor Martin Puryear, in 1991. An abstract distillation of the black experience that had its premiere at the Brooklyn Academy, it was acclaimed by critics. Over the years in which Mr. Fagan has continued to explore new pathways in dance, pushing back against those who sometimes found his work hard to define, his company of seven men and seven women has toured throughout the world.

The former Knights of Columbus building here is home to the Garth Fagan Dance School, a three-week summer institute and administrative offices. The walls are dotted with poster-size reviews. Mr. Fagan began his career as a dancer, studying with Martha Graham, Pearl Primus, Alvin Ailey and José Limón and later creating work for Ms. Jamison, Dance Theater of Harlem, Limón Dance Company and the New York City Ballet. His own dancers receive a salary and benefits; they do not work under contract, as they do in many companies.

"He really nurtures us so much that he can tell exactly what each dancer needs to stretch them," Mr. Pennewell said. "His legacy is his standards. He is a very hard-working person who has never, ever rested on his laurels. You have to take it to the wall every day."

Mr. Fagan has been known quietly to aid students and young dancers without resources, said Ruby P. Lockhart, the executive director of the company. Its dancers draw audiences and the company receives generous financial support from local sources and foundations, but Mr. Fagan lamented that he remained a large contributor.

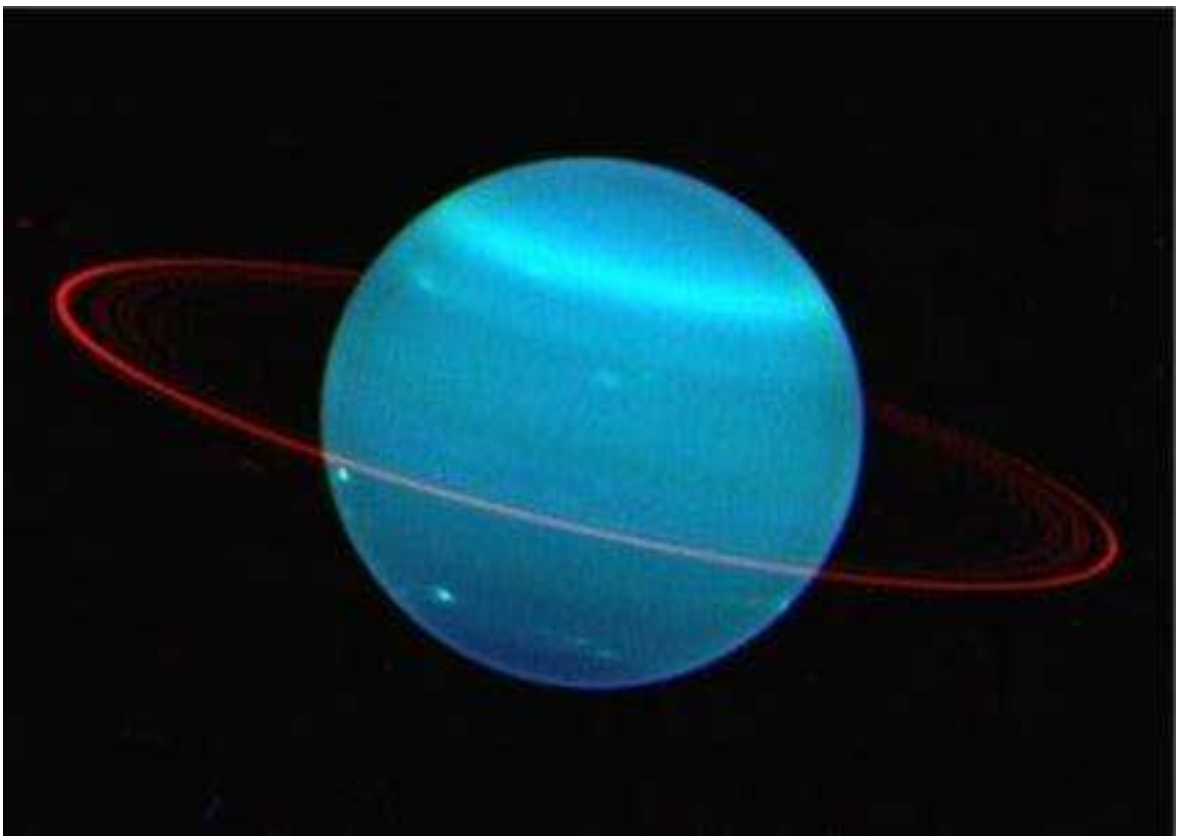
"Everybody's having problems" because of the economy, he said.

"My curse is I love details, and I could eat, sleep and dream this," he said at the end of the workday, sitting in his home in a quiet residential area where the only sound came from the cries of his 10 pet birds. "I love the process of going for perfection."

Garth Fagan Dance appears from Tuesday to Sunday at the Joyce Theater, 175 Eighth Avenue, at 19th Street, Chelsea; (212) 242-0800 or joyce.com.

http://www.nytimes.com/2011/10/03/arts/dance/garth-fagan-finds-inspiration-in-nelson-mandela.html?ref=design

Series of Bumps Sent Uranus Into Its Sideways Spin, New Research Suggests



Near-infrared views of Uranus reveal its otherwise faint ring system, highlighting the extent to which it is tilted. (Credit: Lawrence Sromovsky, (Univ. Wisconsin-Madison), Keck Observatory)

ScienceDaily (Oct. 6, 2011) — Uranus' highly tilted axis makes it something of an oddball in our Solar System. The accepted wisdom is that Uranus was knocked on its side by a single large impact, but new research being presented at the EPSC-DPS Joint Meeting in Nantes rewrites our theories of how Uranus became so tilted and also solves fresh mysteries about the position and orbits of its moons. By using simulations of planetary formation and collisions, it appears that early in its life Uranus experienced a succession of small punches instead of a single knock-out blow. This research has important ramifications on our theories of giant planet formation.

Uranus is unusual in that its spin axis is inclined by 98 degrees compared to its orbital plane around the Sun. This is far more pronounced than other planets, such as Jupiter (3 degrees), Earth (23 degrees), or Saturn and Neptune (29 degrees). Uranus is, in effect, spinning on its side.

The generally accepted theory is that in the past a body a few times more massive than Earth collided with Uranus, knocking the planet on its side. There is, however, one significant flaw in this notion: the moons of Uranus should have been left orbiting in their original angles, but they too lie at almost exactly 98 degrees.

This long-standing mystery has been solved by an international team of scientists led by Alessandro Morbidelli (Observatoire de la Cote d'Azur in Nice, France), who is presenting his group's research at the EPSC-DPS Joint Meeting in Nantes, France.

Morbidelli and his team used simulations to reproduce various impact scenarios in order to ascertain the most likely cause of Uranus' tilt. They discovered that if Uranus had been hit when still surrounded by a protoplanetary disk -- the material from which the moons would form -- then the disk would have reformed into a fat doughnut shape around the new, highly-tilted equatorial plane. Collisions within the disk would have flattened the doughnut, which would then go onto form the moons in the positions we see today.

However, the simulation threw up an unexpected result: in the above scenario, the moons displayed retrograde motion -- that is to say, they orbited in the opposite direction to that which we observe. Morbidelli's group tweaked their parameters in order to explain this. The surprising discovery was that if Uranus was not tilted in one go, as is commonly thought, but rather was bumped in at least two smaller collisions, then there is a much higher probability of seeing the moons orbit in the direction we observe.

This research is at odds with current theories of how planets form, which may now need adjusting. Morbidelli elaborates: "The standard planet formation theory assumes that Uranus, Neptune and the cores of Jupiter and Saturn formed by accreting only small objects in the protoplanetary disk. They should have suffered no giant collisions. The fact that Uranus was hit at least twice suggests that significant impacts were typical in the formation of giant planets. So, the standard theory has to be revised."

Story Source:

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

http://www.sciencedaily.com/releases/2011/10/111006084235.htm

Why Climate Models Underestimated Arctic Sea Ice Retreat: No Arctic Sea Ice in Summer by End of Century?

According to a recent study, the disappearance of Arctic sea ice could occur more quickly than predicted by climate models. (Credit: © Lucas Girard)

ScienceDaily (Oct. 6, 2011) — In recent decades, Arctic sea ice has suffered a dramatic decline that exceeds climate model predictions. The unexpected rate of ice shrinkage has now been explained by researchers at CNRS, Université Joseph Fourier and Massachusetts Institute of Technology. They argue that climate models underestimate the rate of ice thinning, which is actually about four times faster than calculations. This model bias is due to the poor representation of the sea ice southward drift out of the Arctic basin through the Fram Strait. When this mechanism was taken into account to correct the discrepancy between simulations and observations, results from the new model suggested that there will be no Arctic sea ice in summer by the end of the century.

This work was published in the *Journal of Geophysical Research* on 29 September 2011.

The Arctic has been losing about 10% of its permanent ice layer every ten years since 1980. Melting of Arctic sea ice has also reached record heights: in mid-September 2007, at the point when sea ice reaches its annual minimum extent, perennial ice covered an area of 4.14 million km²(1). This record low level was nearly reached again in September 2011 (4.34 million km^2). Climate simulations conducted for the IPCC(2) simulate the decline in Arctic sea ice resulting from global warming. They predict that summer ice will disappear altogether at the end of this century. However, when compared with 30 years of detailed satellite observations, these models appear optimistic. Arctic sea ice has thinned on average four times faster over the

period 1979-2008 than in the climate simulations. True observations are therefore not correctly reproduced by these climate models, which were mainly calibrated using global variables, such as world average rather than "regional" temperature.

An explanation for this difference has been put forward by a Franco-American team, involving in particular the Laboratoire de glaciologie et géophysique de l'environnement (CNRS / Université Joseph Fourier). It may be due to a misrepresentation of the mechanical behavior of pack ice and the drift of sea ice in the models. To demonstrate this, the researchers examined the mechanisms of sea ice drift with respect to their physical state (thickness and concentration), then analyzed the model predictions in combination with field data. In 2009, these same scientists demonstrated that there had been a significant acceleration of ice drift in recent decades. This can now be explained by ice thinning, which has accelerated. Sea ice has become thinner and more fragile. Because it breaks up more easily, its mobility is increased, as is its export from the Arctic Ocean through the Fram Strait between Greenland and the Svalbard archipelago, followed by its melting. This mechanism may be exacerbating the present decline in Arctic sea ice.

The drift of sea ice is poorly described by the models, which do not take drift acceleration or southward evacuation of the ice into account. "Modeled" sea ice behaves as though it drifts freely, without any mechanical interaction between ice fragments, whatever the season, period or ice thickness. There is no link in the models between the thinning of the ice and the further acceleration of its drift.

To close this gap between simulations and observations in terms of Arctic sea ice thinning rates and decline, the models should take into account an acceleration of ice export through the Fram Strait. This mechanism suggests that, well before the end of the century, the Arctic Ocean will be devoid of sea ice in late summer. The disappearance of Arctic sea ice will probably occur in the next few decades, with far-reaching consequences for ecosystems, sea routes and off shore exploitation of resources.

1 -- Compared with 7.5 km^2 on average 30 years ago 2 -- Simulations established for the IPCC 2007 report.

Story Source:

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

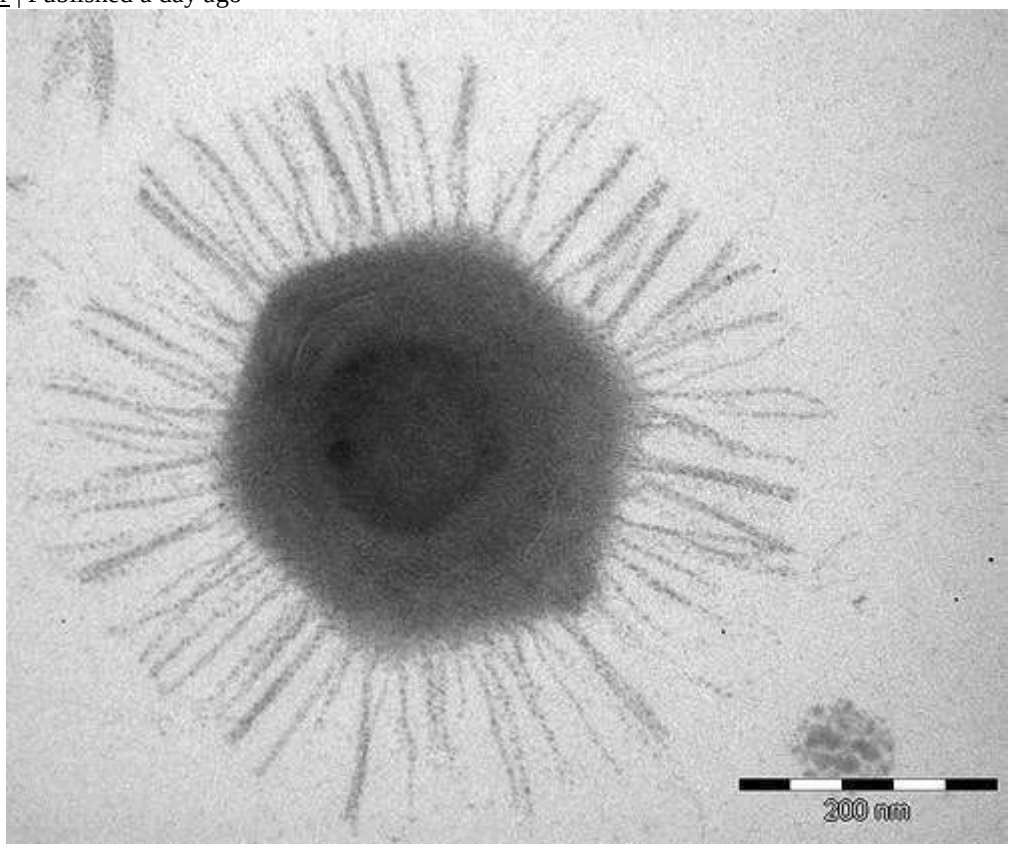
Journal Reference:

1. P. Rampal, J. Weiss, C. Dubois, J.-M. Campin. **IPCC climate models do not capture Arctic sea ice drift acceleration: Consequences in terms of projected sea ice thinning and decline**. *Journal of Geophysical Research*, 2011; 116 DOI: 10.1029/2011JC007110

http://www.sciencedaily.com/releases/2011/10/111006084040.htm

Giant viruses may have evolved from cellular organisms, not the other way around

By John Timmer | Published a day ago



About five years ago, biologists were surprised by the first discovery of an extremely large virus. Viruses are generally stripped down, efficient predators, only carrying as much DNA or RNA necessary to hijack their host and make extra copies of themselves. The newly discovered virus, called Mimivirus, was anything but stripped down; it carried a genome nearly the size of some bacterial species. And, instead of simply hijacking its host, the viral genome carried a lot of genes that replaced basic cellular functions, including some involved in DNA repair and the maufacturing of proteins.

The unusual size and gene content of the virus led one scientist to suggest that viruses could explain the origin of DNA-based life. If viruses carried all these genes, then it's possible to imagine that one could set up shop in a cell and simply never leave, gradually taking over the remaining functions once performed by its host's genetic material. This would explain the origin of DNA, which would distinguish the virus from its host's genetic material, a holdover from the RNA world. It could also explain the existence of a distinct nucleus within Eukaryotic cells.

A paper is being released today, however, that argues that this scenario has things exactly backwards. Giant viruses, its authors argue, have all these genes normally associated with cells because, in their distant evolutionary past, they were once cells.

Mimivirus was discovered in an amoeba, so the authors of the new paper used a simple technique to look for its relatives: take three different species of amoeba, expose them to a variety of environmental samples, and see if anything big starts growing in them. They hit pay dirt with a sample obtained from an ocean monitoring

station just off the coast of Chile. Despite the oceanic source, the virus grew nicely in fresh water amoebae. The site also gave the virus its name: *Megavirus chilensis*.

The authors followed its lifestyle, showing that it behaved much like Mimivirus, forming similar structures within its host cell that could only be distinguished using electron microscopy. They also sequenced its entire genome, which turned out to be the largest virus genome yet completed: 1.26 million base pairs of DNA (Megabases). Based on this sequence, Megavirus is a distant cousin of Mimivirus. Of its 1,120 protein-coding genes, over 250 have no equivalent in Mimivirus. But, of the genes that are shared, the sequences average about 50 percent identity on the protein level. This means that Megavirus is similar enough that it can be compared to Mimivirus, but different enough that it's possible to make some inferences about the viruses' evolutionary history.

And what they find supports the view that the virus started out with a much larger complement of genes. For example, Mimivirus has a suite of genes that can help repair DNA. Megavirus has those plus one other that is specialized for the repair of DNA damaged by UV light. The additional gene appears to be functional: Megavirus was able to grow following an exposure to UV that was sufficient to disable Mimivirus.

Both viruses share an identical set of genes involved in transcribing their DNA into RNA, and use an identical set of signals to indicate where the transcripts should start and stop. Mimivirus also contains a number of genes used in the translation of RNA into protein. Megavirus has those plus a few more, including additional genes that attach amino acids (components of proteins) onto RNAs for use in translation.

Clearly, the common genes suggest that the viruses share a common ancestor. This leaves two possibilities for the novel ones: either the ancestral virus had a larger collection and its descendants have lost different ones, or each virus picked up different genes from its hosts through a process called horizontal gene transfer. The authors favor the former explanation, because most of the genes specific to one of the two viruses don't look like any gene present in their hosts (or any other gene we've ever seen, for that matter). This implies that horizontal gene transfer doesn't seem to have done much to shape the viruses' genomes.

So, when did the common ancestor exist? The authors line up a few of the conserved megavirus genes (including those of a more distantly related giant virus, CroV) with the equivalents in other eukaryotic species, and find that they branch off right at the base of the the eukaryotic lineage. In other words, the viruses seem to have had a common ancestor with eukaryotes, but it split off right after the eukaryotes diverged from bacteria and archaea. (This also argues against the horizontal gene transfer idea, since there doesn't seem to be a species out there that the genes could have been transferred from.) To the authors, this suggests that the viruses are the evolutionary descendants of an ancient, free-living eukaryotic cell. Various genes and structures from that organism have gradually been lost over its long history as a parasite, leaving something that propagates like a virus, but belongs to a distinct lineage from all other viruses that we're aware of.

The authors make a reasonably compelling case against the megaviruses getting their complex genomes via horizontal gene transfer, although it would be good to see a similar analysis for a lot more of the shared genes. What they don't do, however, is rule out the initial alternative: it's still technically possible that the megaviruses and eukaryotes share an ancient common ancestor because all eukaryotes are descendants of the virus' genome. At the moment, I'm not sure it's possible to distinguis between these alternative explanations.

PNAS, 2011. DOI: 10.1073/pnas.1110889108 (About DOIs).

Image courtesy of Stanford University

http://arstechnica.com/science/news/2011/10/giant-viruses-may-have-evolved-from-cellular-organisms-not-the-other-way-around.ars

Pumice Proposed as Home to the First Life Forms

Pumice. (Credit: © Jakub Cejpek / Fotolia)

ScienceDaily (Oct. 5, 2011) — The glassy, porous, and once gas-rich rock called pumice may have given rise to early life forms, according to a provocative new hypothesis on the origin of life published in *Astrobiology*.

Martin Brasier, Richard Matthewman, and Sean McMahon, University of Oxford (U.K.), and David Wacey, University of Western Australia (Crawley), contend that pumice has "four remarkable properties" that would enable it to have had "a significant role in the origin of life and provided an important habitat for the earliest communities of microorganisms." They describe those four properties in detail in the article "Pumice as a Remarkable Substrate for the Origin of Life."

To validate their hypothesis, the authors call for laboratory research to test the ability of pumice rock to adsorb organic compounds from water and create catalysts and new compounds by simulating the thermal cycles, UV light, and other conditions that existed when the first organic polymers and microbes co-existed.

"The hypothesis that pumice provided a unique physical substrate in which life got its start is exciting and testable," says Sherry L. Cady, PhD, Editor-in-Chief of *Astrobiology* and Professor in the Department of Geology at Portland State University. "Key for astrobiology is whether such rock types preserved evidence of pre-biotic reactions or ancient life forms in the rock record."

Astrobiology is a peer-reviewed journal published by Mary Ann Liebert, Inc.

Story Source:

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

Journal Reference:

1. Martin D. Brasier, Richard Matthewman, Sean McMahon, David Wacey. **Pumice as a Remarkable Substrate for the Origin of Life**. *Astrobiology*, 2011; 11 (7): 725 DOI: 10.1089/ast.2010.0546

http://www.sciencedaily.com/releases/2011/10/111004132545.htm