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The eight failures that caused the Gulf oil spill

- 16:09 08 September 2010 by **Justin Mullins**

Eight catastrophic failures led to the explosion that destroyed the Deepwater Horizon drilling rig in the Gulf of Mexico, killing 11 people and leading to one of the biggest oil leaks in history, according to BP's long-awaited investigation into the accident.

BP accepts its role in the disaster but also points the finger at two of its contractors.

The accident occurred on 20 April as the team aboard Deepwater Horizon was preparing to temporarily abandon a well it had drilled some 70 kilometres from the US coast.

The day before the accident, the crew had pumped cement to the bottom of the borehole, a standard procedure intended to prevent oil leaking out. On the day of the accident, the team were conducting checks to determine that that the well had been properly sealed.

BP says the accident was caused by the failure of eight different safety systems that were meant to prevent this kind of incident:

Dodgy cement

The cement at the bottom of the borehole did not create a seal, and oil and gas began to leak through it into the pipe leading to the surface. BP says the cement formulation seems not to have been up to the job.

Valve failure

The bottom of the pipe to the surface was sealed in two ways. It too was filled with cement, and it also contained two mechanical valves designed to stop the flow of oil and gas. All of these failed, allowing oil and gas to travel up the pipe towards the surface.

Pressure test misinterpreted

The crew carried out various pressure tests to determine whether the well was sealed or not. The results of these tests were misinterpreted, so they thought the well was under control.

Leak not spotted soon enough

Whether a well is under control or not, the crew at the surface should be able to detect a flow of oil and gas towards the surface by looking for unexpected increases in pressure in the well. Exactly this kind of increase occurred about 50 minutes before the rig exploded, but it was not interpreted as a leak.

Valve failure no. 2

About 8 minutes before the explosion, a mixture of mud and gas began pouring onto the floor of the rig. The crew immediately attempted to close a valve in a device called the blowout preventer, which sits on the ocean floor over the top of the well borehole. It did not work properly.

Overwhelmed separator

The crew had the option of diverting the mud and gas away from the rig, venting it safely through pipes over the side. Instead, the flow was diverted to a device on board the rig designed to separate small amounts of gas from a flow of mud. The so-called mud-gas separator was quickly overwhelmed and flammable gas began to engulf the rig.

No gas alarm

The rig had an onboard gas detection system that should have sounded the alarm and triggered the closure of ventilation fans to prevent the gas reaching potential causes of ignition, such as the rig's engines. This system failed.

No battery for BOP

The explosion destroyed the control lines the crew were using to attempt to close safety valves in the blowout preventer. However, the blowout preventer has its own safety mechanism in which two separate systems should have shut the valves automatically when it lost contact with the surface. One system seems to have had a flat battery and the other a defective switch. Consequently, the blowout preventer did not close.

"It is evident that a series of complex events, rather than a single mistake or failure, led to the tragedy. Multiple parties, including BP, [oilfield services company] Halliburton and [offshore drilling company] Transocean, were involved," said Tony Hayward, BP's chief executive.

http://www.newscientist.com/article/dn19425-the-eight-failures-that-caused-the-gulf-oil-spill.html

Heady Intersections of Ancient and Modern

By KEN JOHNSON

Wandering around the Rubin Museum of Art, which specializes in traditional art of the Himalayas, you happen upon a case containing a set of curious, cylindrical, silvery objects. Looking closely, you discover they are not antique artifacts but beer cans with their printed surfaces sanded away. More scrutiny reveals that their bottoms have been perforated by a pointed instrument, and that if you examine the other end and peer in through the drinking hole, you see a glowing, dotted-line image of a Tantric deity.

Representing both sacred and profane forms of intoxication, these sculptures by Kesang Lamdark put in a nutshell the main themes of "Tradition Transformed: Tibetan Artists Respond," the Rubin's first foray into exhibiting contemporary art. All nine artists — their birthdates range from 1953 to 1982 and only two still live in Tibet — address relations between traditional craftsmanship and modern ideas about creating art. Surprisingly, given Tibet's violent post-World War II history, none of them deal with politics directly, nor do they express anything very personal about their own experiences.

That few speak to old-new, East-West tensions in very surprising, deep or challenging ways does not make the show less interesting to think about. This is rich philosophical territory. The more the culture of corporate capitalism dominates the planet, the more urgent becomes the question of what happens to traditional, local cultures. Do they become extinct? Can they be modernized without losing their souls? Can their essences be recast in nontraditional forms?

Another piece by Mr. Lamdark, who lives in Zurich, delves promisingly into a different form of intoxication. Back-lighted pin-prick holes in a four-foot-diameter black disk create a complex mandala pattern punctuated by skulls and animals and sexual imagery from traditional Buddhist art sources and modern pornography. Differing attitudes about the erotic in Eastern and Western cultures and the debasement of sex in modern commerce are certainly worth further investigation. Of all the show's artist's, Mr. Lamdark is the one to watch.

Gonkar Gyatso, who lives in London, tackles commercialism with collages made by adhering to paper hundreds of little stickers imprinted with familiar logos, cartoon characters and other signs of corporate empire. He thus creates atomized silhouettes of the Buddha. Mr. Gyatso's works are graphically appealing, but they don't do much to advance the genre of Pop collage or ideas about spirituality and business.

A large watercolor by Tsherin Sherpa, of Oakland, Calif., features an angry blue giant with a vulture perched on his shoulder and flames roiling behind him. His rotund body is overlaid by schematic lines and small boxes labeled in Tibetan script, which could represent some kind of esoteric, mystical system but might also just as well be an industrial flow chart or a diagram of cybernetic circuitry. In other large watercolors by Tenzing Rigdol, of New York, grids of crisscrossing bands are layered over colorfully traditional imagery of deities and ornamentation. You could say that such works represent a convergence of opposite kinds of consciousness: one that thinks rationalistically in the most abstract terms possible and one that cogitates by means of visual and poetic metaphors.

But neither conceptual nor metaphorical thought is very intensely developed in this show. Large, colorful, computer-generated prints picturing abstracted traditional motifs by Losang Gyatso, of Washington, are technically impressive and optically vivid, but if Buddha-mindedness has anything to do with digital consciousness, we need to see more. Paintings of curvy, variously patterned shapes gathered into Cubist clusters by Pema Rinzin, of New York, are uncomfortably close to hotel lobby decoration.

Dedron, who goes by one name, lives in Tibet and is the show's only woman. She presents a cartoonish painting of big-eyed male and female couples embedded in profuse gold patterning and an aerial view of a village populated by little, bug-eyed characters. Projecting nostalgia for preindustrial times, they resemble a modern children's book version of folk art.

Potential for narrative and symbolic elaboration may be greatest for Penba Wangdu, also of Tibet, and Tenzin Norbu, of Nepal, though their paintings on view here are disappointingly decorous. In Mr. Wangdu's "Links of Origination," the elegant outlines of a transparent sleeping woman contain a dreamy, pastoral landscape where little people make love, give birth, drink beer and paddle a boat on a peaceful lake.

Mr. Norbu's paintings resemble enlarged panels from a comic-book version of Tibetan religion. (Tintin comes to mind.) In "Liberation" a giant, kindly woman in a mountainous landscape oversees little figures of nude women climbing a stairway to a tabletop where they turn into vessels holding flaming candles. Like Mr. Wangdu's paintings, Mr. Norbu's works are suggestive, but too mild considering the possibilities for picturing the complexities and contradictions of contemporary life. Think of all the sex and violence in traditional Hindu and Buddhist art.

The paradox is that despite the freedoms granted by modern art and culture, none of the show's artists is showing anything more wildly imaginative than classic Tibetan artists did for hundreds of years prior to the 20th century. The Rubin has scheduled more shows of contemporary art for the future; maybe more adventurous minds will emerge.

"Tradition Transformed: Tibetan Artists Respond" continues through Oct. 18 at the Rubin Museum of Art, 150 West 17th Street, Chelsea; (212) 620-5000, rmanyc.org.

http://www.nytimes.com/2010/08/20/arts/design/20tradition.html?ref=design

The Sea and the English Who Tried to Master It

By EDWARD ROTHSTEIN

WASHINGTON — We know well the hazards latent in the sea. For months, we have watched millions of barrels of oil erupting from the ocean floor, just after its explosive force claimed the lives of 11 workers who toiled on precarious platforms perched above the waves. We have also, in recent years, watched waters engulf the shores and dwellings of New Orleans, wreaking havoc as in ancient tales.

But it is doubtful that we take the ocean really seriously — as seriously, that is, as the people who wrote the books and pamphlets, drew the maps and learned the ropes and knots on display in an exhibition at the Folger Shakespeare Library here did.

Its subtitle, "The Ocean in the English Imagination, 1550-1750," might suggest the lulling drone of academic solemnity, while its main title, "Lost at Sea," might evoke something far more tempestuous. But the show, which draws on the Folger's collection of rare books, a few unusual loans and reproductions of seafaring apparatus, calmly pieces together an alien cosmos: a world that resembles our own in many respects but whose inhabitants, though far more ignorant about many things, can seem far more knowing about others.

There is probably nothing in contemporary life comparable to the role the ocean played in that period. The curator, Steve Mentz, who teaches English at St. John's University in New York, has a keen interest in Shakespeare's images of the sea — something that is particularly helpful for the larger vision he outlines.

At the beginning of the 17th century, the ocean was scarcely understood and riskily charted. It was also the medium for the exercise of international power, the site of exploratory fantasy and the terrain over which Divine Providence exacted mysterious judgments. All strands of human knowledge and experience were associated with the ocean. "Technological know-how and cartographic knowledge were essential," the exhibition tells us, "but so also were narrative understanding and religious faith."

This was particularly true for England, an island nation that could thrive only through mastery of the sea. Many of the 16th-century English books here are translations of volumes from more established seafaring

cultures. A 1596 copy of Martín Cortés's "Arte of Navigation" translated the Spanish reference book into English and provided a model for others. "The Mariners Mirrour" (around 1588) "transformed" a Dutch atlas, but also staked a new claim in its hand-colored frontispiece, which optimistically placed the English nation at the glorious center of the maritime world.

Many 16th-century works about navigation are actually books of mathematics, because the skill required knowledge of both geometry and astronomy. Robert Record's "Castle of Knowledge" (1556), we are told, may be one of the first books of "English vernacular mathematics" teaching geometric principles, though as the exhibition points out, Record's English terminology did not quite displace the Greek: the pentagon never became known as the cinkeangle.

A 1559 book by William Cunningham, a physician and favorite of Queen Elizabeth, is even more ambitious; it is called "The Cosmographical Glasse, Conteinyng the Pleasant Principles of Cosmographie, Geographie, Hydrographie, or Navigation." The book names itself as a "glasse," a mirror, in which the entire cosmos can be discerned and ordered, with the navigator himself at its stable center.

It is with this combined notion of celestial order and navigation that Shakespeare's sonnet on "the marriage of true minds" takes its bearings. In the first 1609 printing shown here, we read that love is like

an ever fixed marke

That looks on tempests and is never shaken;

It is the star to every wandring barke

But against that ideal there was the sea itself, with unpredictable ragings of tempests, foundering ships and watery deaths leaving no bodies behind. An unusual woman's ring here from 1592, made of gold and rock crystal, is called a "memorial poesy ring"; on its inner surface is inscribed, "The cruel seas, remember, took him in November." Imagining such a fate could be as horrifying as the death itself. A 1709 edition of Shakespeare's "Tempest" shows a none-too-steady "wandring barke" overwhelmed by Ariel's terrible storm.

The ocean, the exhibition reminds us, became in Shakespeare's plays both "a literal setting and metaphor for instability." It also implied a spiritual instability, a powerful conception that reached across three centuries into the world of "Moby-Dick."

But in these earlier times, the sailor and the sea were elements of an archetypal religious drama, regularly addressed in sermons. A moral compass was as necessary, many of them taught, as a magnetic one, a divine anchor as steadying as the weighty one on display here. No doubt this message was a warning to sailors about the lives they tended to lead, but it was also a signal to the landbound.

One 1721 image here shows a providential eye peering through the clouds of a storm, beams of light streaming downward to illumine an embattled ship. The sermons on display include John Flavel's 1698 book, "Navigation Spiritualiz'd," which argued, the exhibition notes, that "sailors were unlike other men because their work brought them into intimate contact with their own possible deaths." They have a special status, Flavel argued, "to be Number'd neither with the Living nor the Dead; their Lives hanging continually in suspense before them."

There is also, of course, the sober recognition of the real as opposed to the ideal, as in an admiral's 1691 assessment of captains in the British Royal Navy, evaluating each with such phrases as "a good Man but young," "Good for nothing" and "Turn'd out for a Coward."

There is even a hint here of the satiric mockery that eventually greeted the culture of the sea, aimed at the explorers who claimed uncommon strength and miraculous adventures. Captain John Smith, who gave the English a foothold in Virginia with the settling of Jamestown, is shown here as an armored "Captaine Jones," jousting at a Roman-garbed ruler riding on an elephant, or, again clad in full armor, perched on the back of a giant fish in the ocean.

But seafarers, those marginal men neither living nor dead, also became central to the English national project, to dreams of colonization and the shaping of a new form of civilization. Daniel Defoe's story of "Robinson Crusoe" became a touchstone. A map of Crusoe's fictional voyages is here from 1719, when the book was published. So is Defoe's 1704 pamphlet, "The Storm," which was an account, with statistics, of the most destructive tempest to hit the British Isles. Combining reason and faith, sobriety and courage, Crusoe may have been deeply injured by the sea, but he also showed what could be made despite of it and because of it.

As for the exhibition itself, there are flaws — it needs a much stronger narrative line — and its subject is so, well, oceanic that the show would have been much more effective with a crisper focus.

But it also brought home, at least to this visitor, a sense of how so much of our attention to the recent oil spill in the Gulf of Mexico and the flooding of New Orleans is focused on just one aspect of disasters.

We have, necessarily of course, been preoccupied with issues of blame, responsibility and cause in such disasters, almost as if we were following the examples of 18th-century sermons about the sea, as if catastrophes could be fully understood as the consequences of evil human actions or the violation of some deep principles of contemporary faith.

Such transgressions and liabilities may well exist, but it is worth recalling that reason and preparation also have their limits. The oil spill might seem a completely man-made mess, the result of some careless drilling, but the nature of the enterprise — plumbing the ocean's resources, daring the dangers of the deep, risking lives to fill elemental needs — is unthinkable without taking the sea's powers and promise into account. Perhaps off-shore drilling is a contemporary form of 19th-century whaling, even in the object of the quest.

But during eras when the ocean — and the natural world — was taken more seriously, it was also understood there can never be a way to completely eliminate hazards or fully control the sea's fearsome powers; before such forces, all lives hang in the balance.

"Lost at Sea: The Ocean in the English Imagination, 1550-1750" continues through Sept. 4 at the Folger Shakespeare Library, 201 East Capitol Street SE, Washington; (202) 544-4600, www.folger.edu.

http://www.nytimes.com/2010/08/19/arts/design/19museum.html?ref=design

50 Years Ago: Photographs of an Antarctic Odyssey

By THOMAS LIN

Robert A. McCabe

In 1959, when Robert A. McCabe ventured to Antarctica as a freelance photojournalist, there were no rules against handling penguins and seals. So when an emperor penguin wandered onto McMurdo Base, Mr. McCabe and his cohorts put the almost three-foot-tall bird on a bar for snapshots. At Cape Royds, he photographed a man holding a diminutive Adélie penguin under its wings as if it were a toddler. Another photograph shows a man about to pet a seal pup.

The military personnel running the base even killed seals to feed the sled dogs, Mr. McCabe said, adding, "Today that's absolutely prohibited."

For the 100th anniversary of Roald Amundsen's and Robert Falcon Scott's race to the South Pole, Mr. McCabe has published a book of photographs and journal entries called "DeepFreeze! A Photographer's Antarctic Odyssey in the Year 1959."

"At that time, the penguins seemed to be very curious beasts. This one that I photographed just appeared at the American base and made the rounds," he said. "He wasn't afraid of anyone or anything."

Robert A. McCabe A Weddell seal pup. Slide Show

Mr. McCabe used a Contax with a Zeiss 35mm lens for his color photographs and a Rolleiflex for black and white exposures. The book's publisher, however, decided to print everything in black and white.

If Mr. McCabe was out for more than 15 minutes, the shutter on the Contax froze so that only half the frame was exposed. The Rolleiflex, he said, never failed.

With the 24-hour days, Mr. McCabe said, he felt guilty putting away his camera to get some shut-eye. He marveled at the “wonderful raking angle” of the sunlight. “The light creates a wonderful texture in the ice that doesn’t look flat.”

In the race to the South Pole, Amundsen’s Norwegian team was first to arrive, on December 14, 1911, more than a month before Scott’s. Tragically, Scott and the other four members of his British team died on their return trip.

http://scientistatwork.blogs.nytimes.com/2010/08/23/50-years-ago-photographs-of-an-antarctic-odyssey/?ref=science

Childhood: Hearing Loss Grows Among Teenagers

By RONI CARYN RABIN

One in five teenagers suffer from at least slight hearing loss, a significant rise from a decade ago, when the rate was only one in seven.

The new study, published Wednesday in The Journal of the American Medical Association, analyzed data on about 1,771 youngsters aged 12 to 19 who participated in the National Health and Nutrition Examination Survey of 2005-6, and compared the prevalence of hearing loss with that of youngsters who took part in the survey in 1988-94.

The percentage with at least slight hearing loss increased by 30 percent, to 19.5 percent from 14.9 percent in the earlier study. For most the hearing loss is slight enough they may not even notice.

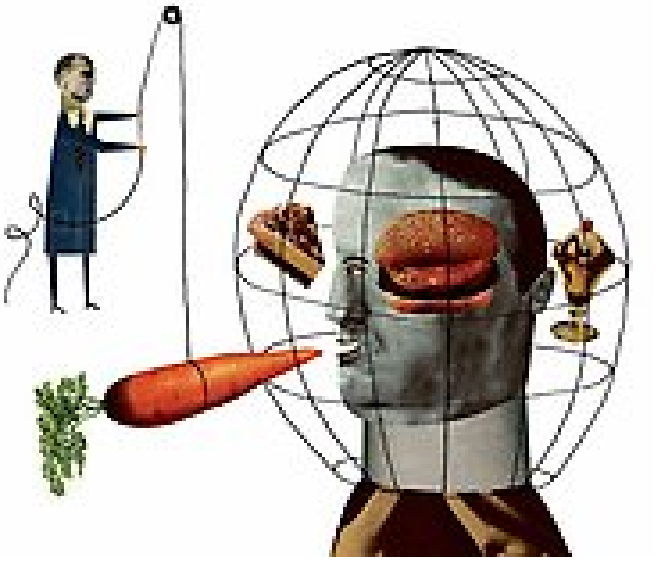
The number with greater hearing loss — called mild hearing loss — has also increased, from 1 in 30 teenagers a decade ago to 1 in 20 teens in 2005-6, the study found. With mild hearing loss, one might not be able to hear a person whispering in one's ear.

Researchers could not explain why hearing loss had become more prevalent, and did not find a significant association with exposure to loud noise. But youngsters often say they are not being exposed to loud noise because they are hrsimply unaware they are listening to music at dangerously high levels, said the paper's lead author, Dr. Josef Shargorodsky, of the Channing Laboratory at Brigham and Women's Hospital.

http://www.nytimes.com/2010/08/24/health/research/24child.html?ref=health

Fixing a World That Fosters Fat

By NATASHA SINGER



WHY are Americans getting fatter and fatter? The simple explanation is that we eat too much junk food and spend too much time in front of screens — be they television, phone or computer — to burn off all those empty calories.

One handy prescription for healthier lives is behavior modification. If people only ate more fresh produce. (Thank you, Michael Pollan.) If only children exercised more. (Ditto, Michelle Obama.)

Unfortunately, behavior changes won't work on their own without seismic societal shifts, health experts say, because eating too much and exercising too little are merely symptoms of a much larger malady. The real problem is a landscape littered with inexpensive fast-food meals; saturation advertising for fatty, sugary products; inner cities that lack supermarkets; and unhealthy, high-stress workplaces.

In other words: it's the environment, stupid.

"Everyone knows that you shouldn't eat junk food and you should exercise," says Kelly D. Brownell, the director of the Rudd Center for Food Policy and Obesity at Yale. "But the environment makes it so difficult that fewer people can do these things, and then you have a public health catastrophe."

Dr. Brownell, who has a doctorate in psychology, is among a number of leading researchers who are proposing large-scale changes to food pricing, advertising and availability, all in the hope of creating an environment conducive to healthier diet and exercise choices.

To that end, health researchers are grappling with how to fix systems that are the root causes of obesity, says Dee W. Edington, the director of the Health Management Research Center at the University of Michigan.

"If you take a changed person and put them in the same environment, they are going to go back to the old behaviors," says Dr. Edington, who has a doctorate in physical education. "If you change the culture and the environment first, then you can go back into a healthy environment and, when you get change, it sticks."

Indeed, despite individual efforts by some states to tax soda pop, promote farm stands, require healthier school lunches or mandate calorie information in chain restaurants, obesity rates in the United States are growing. An estimated 72.5 million adults in the United States are obese, according to the Centers for Disease Control and Prevention. Last year, about 27 percent of adults said they were obese, compared with about 20 percent in 2000, as reported in a C.D.C. study published this month. And, the report said, obesity may cost the medical system as much as $147 billion annually.

So what kind of disruptive changes might help nudge Americans into healthier routines? Equalizing food pricing, for one.

Fast-food restaurants can charge lower prices for value meals of hamburgers and French fries than for salad because the government subsidizes the corn and soybeans used for animal feed and vegetable oil, says Barry Popkin, a professor of nutrition at the Gillings School of Public Health at the University of North Carolina at Chapel Hill.

"We have made it more expensive to eat healthy in a very big way," says Dr. Popkin, who has a doctorate in agricultural economics and is the author of a book called "The World Is Fat: The Fads, Trends, Policies and Products That Are Fattening the Human Race."

The inflation-adjusted price of a McDonald's quarter-pounder with cheese, for example, fell 5.44 percent from 1990 to 2007, according to an article on the economics of child obesity published in the journal Health Affairs. But the inflation-adjusted price of fruit and vegetables, which are not subject to federal largess, rose 17 percent just from 1997 to 2003, the study said. Cutting agricultural subsidies would have a big impact on people's eating habits, says Dr. Popkin.

"If we cut the subsidy on whole milk and made it cheaper only to drink low-fat milk," he says, "people would switch to it and it would save a lot of calories."

Health experts are also looking to the private sector. On-site fitness centers and vending machines that sell good-for-you snacks are practical workplace innovations that many companies have instituted.

On a more philosophical level, innovative companies are training managers not to burn out employees by overworking them, says Dr. Edington of the University of Michigan.

"Stress comes up. It can lead to overeating and obesity," Dr. Edington says. At companies that see employee health as a renewable resource, he adds, managers encourage employees to go home on time so they can spend more time with their families, communities or favorite activities. "Instead of going home with an empty tank, you can go home with the energy that we gave you by the way we run our business," he says.

CORPORATE-SECTOR efforts aren't entirely altruistic. It's less expensive for businesses to keep healthy workers healthy than to cover the medical costs of obesity and related problems like diabetes. For employees at I.B.M. and their families, for example, the annual medical claim for an obese adult or child costs about

double that of a non-obese adult or child, says Martin J. Sepulveda, I.B.M.'s vice president for integrated health services.

I.B.M. has been promoting wellness for employees since the 1980s. But in 2008, it began offering a new program, the Children's Health Rebate, to encourage employees to increase their at-home family dinners, their servings of fruits and vegetables, and their physical activities, as well as to reduce their children's television and computer time.

In addition to helping prevent obesity in children, Mr. Sepulveda says, the program is aimed at employees who might neglect to exercise on their own but would willingly participate as part of a family project. Each family that completes the program receives $150.

All of these ideas sound promising. But the architecture of obesity is so entrenched that policy makers, companies, communities, families and individuals will need to undertake a variety of efforts to displace and replace it, says Alan Lyles, a professor at the School of Health and Human Services at the University of Baltimore.

And American efforts can seem piecemeal compared with those in Britain, where the government has undertaken a multipronged national attack, requiring changes in schools, health services and the food industry.

Britain now places restrictions on advertising fatty, sugary and salty foods during children's shows, for example. And by 2011, cooking classes will be mandatory for all 11- to 14-year-old students in the nation. The hope is to teach a generation of children who grew up on prepared foods how to cook healthy meals, and perhaps to make eating at home — instead of at the local fried fish-and-chips shop — the default option.

http://www.nytimes.com/2010/08/22/business/22stream.html?ref=health

Birth Control Doesn't Have to Mean the Pill

By MICHELLE ANDREWS

THERE was a time when Becky Thurmond Fowler neglected to take her birth control pills for days on end. But she didn't worry, because she and her husband, Dan, wanted to have a child at some point. "It wouldn't have been the end of the world if I got pregnant," she said.

That attitude changed after Ms. Fowler had a daughter, Emerson, now 2 1/2. But with a new baby demanding all her attention, Ms. Fowler, now 33, found herself becoming even more forgetful about taking the pills. Soon she began to worry about the possibility of an unexpected pregnancy: "We were just rolling the dice."

Many women struggle to find a birth control strategy that is effective given their particular circumstances. About half of all pregnancies — three million annually — are unintended. About half of the women who have an unplanned pregnancy are using birth control at the time, according to a 2009 study by the Guttmacher Institute.

The pill, which celebrates its 50th anniversary this year, is by far the most popular contraceptive choice among women. When used consistently, it is more than 90 percent effective. The problem, as countless women have found, is that it is easy to forget to take the daily dose.

"Women, and men, just can't take a daily pill," said James Trussell, director of the Office of Population Research at Princeton.

Women choose a form of contraception for any number of reasons: reliability, convenience, familiarity. While the pill is the most frequent choice, it is not always the most appropriate. Pills are relatively inexpensive month-to-month, but a method with heftier upfront costs may be a better buy in the long run.

"An unplanned pregnancy is emotionally and financially expensive," said Dr. Steven J. Sondheimer, a professor of obstetrics and gynecology at the University of Pennsylvania who directs its family planning program.

Ms. Fowler, a technology security analyst at the University of Missouri, decided to try something more suited to her life and kinder to her pocketbook: a small, T-shaped intrauterine device, or I.U.D., that slowly releases the hormone progestin, which prevents pregnancy in part by altering the uterine lining. Ms. Fowler paid $100 in outpatient surgery charges for the insertion; her insurance covered the roughly $700 cost of the device.

Even if she had had to pay the full cost herself, the I.U.D. — which prevents pregnancy for five years — would still be more cost-effective than birth control pills, which typically cost $15 to $50 a month. And of course there is no forgetting with an I.U.D.

For women who realize the time has come to re-evaluate their birth control strategy, there are many methods to choose from: I.U.D.'s, hormonal implants, shots, the "patch" and the vaginal ring, to name a few. Here are some factors to consider.

LONG-TERM OPTIONS If you have a hectic job or small children, or are caring for elderly parents, the pill may not be the best method for you, said Dr. Vanessa Cullins, vice president for medical affairs for the Planned Parenthood Federation of America.

The I.U.D. is the gold standard for the attention-challenged, Dr. Cullins said, as it remains effective for up to 12 years. On a dollar-for-dollar basis, it is also clearly the most cost-effective method, unless you plan to stop birth control altogether in the near future.

Similar options include hormonal methods like the Ortho Evra Patch, which is replaced once a week; the NuvaRing vaginal ring, which remains in place for three weeks; the Depo-Provera shot, which contains pregnancy-preventing hormones effective for three months; and Implanon hormonal implants.

Planned Parenthood offers an interactive tool on its Web site that helps women sort through the expanding array of contraceptive options.

INSURANCE COVERAGE While most insurance plans include contraceptive services and supplies, they may not cover all possibilities.

Twenty-seven states require health insurance plans that cover prescription drugs to cover the full range of Food and Drug Administration-approved contraceptive methods, according to the Guttmacher Institute. The plans may not, however, cover every type of device or drug, experts caution. Some plans cover only generic birth control pills, for example, not brand-name pills.

Since coverage varies widely, you will need to inquire about specific options you are considering. Your policy may cover the doctor's visit, for instance, for a Depo-Provera shot or to insert Implanon hormonal implants and I.U.D.'s — but not the shot or the device itself.

More than half of America's employees work for companies with self-financed plans, which pay employees' health claims directly. Those plans are not bound by the state coverage requirements. Small-business and individual policies also tend to provide less comprehensive contraceptive coverage, experts note.

Whatever the type of plan, co-payments and co-insurance charges can be steep, sometimes discouraging women from picking the method that best suits them.

High-deductible plans can pose a particular challenge. They may not cover any birth control costs at all until patients meet a deductible of $1,000 or more.

Those out-of-pocket costs can be a serious barrier to women considering other options. A study of patients at Kaiser Permanente Northern California published in 2007 found that when co-payments totaling hundreds of dollars per patient were eliminated for longer-acting methods like I.U.D.'s and implants, their use increased sharply.

The new health care law may help women faced with high out-of-pocket costs. The law requires new health plans to provide certain preventive benefits with no cost-sharing, and family-planning advocates are pushing for birth control to be included among them. Federal regulations are expected within a year.

AN EXPERIENCED PROVIDER The options presented by your doctor may not include the best choices for you. Some physicians' practices are not very familiar with longer-acting, more expensive methods like I.U.D.'s, implants and shots, or do not stock them.

"If you're not getting requests for I.U.D.'s, it can be expensive to keep it on the shelves," said Adam Sonfield, a senior public policy associate at the Guttmacher Institute. "For small practices, that can be a big deal."

If your doctor has limited experience with the range of options, visit a larger practice or a family-planning clinic, where they are more likely to offer the full range of F.D.A.-approved products.

Family-planning clinics like Planned Parenthood are a good choice, too, particularly if you are unemployed or do not have insurance, as are state and county health departments and some university clinics, said Laura Hessburg, senior health policy adviser at the National Partnership for Women and Families. These facilities serve all comers, and fees are generally based on a sliding scale for limited-income women.

TRIAL AND ERROR Many women like the pill and other hormonal methods for reasons unrelated to preventing pregnancy: to regulate their periods, for example, or to reduce heavy menstrual flow.

While most women can use most F.D.A.-approved methods, experts say, it may take some trial and error to find a method that minimizes side effects.

For Whitney Hauser, 45, from Plymouth, Minn., birth control pills set off migraines. Switching to an I.U.D. three years ago solved the problem.

"I love it," she said. "I don't have to think about it anymore."

http://www.nytimes.com/2010/08/21/health/21patient.html?ref=health

Living With the Aches That Won't Go Away

By HELEN EPSTEIN

THE PAIN CHRONICLES

Cures, Myths, Mysteries, Prayers, Diaries, Brain Scans, Healing, and the Science of Suffering

By Melanie Thernstrom

364 pages. Farrar, Straus & Giroux. $27.

For the fortunate, pain is temporary and finite, with a clear beginning, middle and end. But for more than 70 million Americans, including Melanie Thernstrom, pain is chronic, and the primary reason that they seek medical care. The medical profession has been slow to recognize this development. There is currently one board-certified pain specialist in the United States for every 25,000 patients, she writes in her new book, "The Pain Chronicles." That number, however, is likely to grow as pain is redefined not as a symptom but as a disease that "can eventually rewrite the central nervous system, causing pathological changes to the brain and spinal cord, and ... greater pain."

There have been hundreds of books published in the last decades on pain and its management, but none that combine memoir, scholarly research and journalistic reportage in the way Ms. Thernstrom, the author of two previous books, does. A stellar example of literary nonfiction (parts of which first appeared in The New York Times Magazine), the book recounts the author's own years with chronic pain and the preconceptions she brought to it (including the idea of pain as the price for romantic love); summarizes its social, cultural and medical history; and gives us a reporter's view of state-of-the-art treatment.

The book has a patchwork quilt structure: more than one hundred small captioned patches (or dispatches), organized into five parts and threaded with personal narrative. This invites differently motivated readers to skip or skim. You can chuckle over the aperçus of poets and philosophers like Aristotle, Coleridge, Dickinson, Sontag, and Foucault in the section entitled "Pain as Metaphor." You can become absorbed, as I was, in the fascinating struggle over the use of anesthesia (and, later, opiates) in "Pain as History," or play voyeur during absorbing clinical vignettes of "Pain as Disease."

Ms. Thernstrom begins with the transformation of the centuries-old mystical disease of consumption, which, in 1882, was finally revealed to be caused by a bacterium. As a result, consumption became tuberculosis — not a curse, not a character weakness, but a disease. Chronic pain, Ms. Thernstrom writes, is currently in the same state of transformation, and because she suffers from an arthritic condition that ranges from irritating to incapacitating, she is bent upon learning the state of the medical art.

She dates the onset of her chronic pain to the day she falls in love with a young academic, the least compellingly drawn of the large cast of characters we meet. They go swimming, and that night she feels an unpleasant burning sensation spread from her neck to her right shoulder, down her right arm to her hand. At first she sees it as “a pointless ache in my neck and shoulders, which I dimly attributed to a structural weakness in my body”; once she realizes that it is chronic, she compares it to “a sour domestic partner — intimate and ugly; a threatening, dirtying, distracting presence, yet one who refused to move out.”

A magazine assignment steers her to what became a kind of narrative therapy, a meditation on pain as seen by art, literature, philosophy, religion and science.

Except for a reference to her favorite grandmother, a Christian Scientist, Ms. Thernstrom tells us little of her family’s attitudes toward pain. We do, however, reap the rewards of her lifelong prodigious reading, as she investigates the cultural connotations of pain, from the etymology of the word in various languages to its interpretations.

Throughout her narrative physicians are both villains and heroes. Ms. Thernstrom gives us glimpses of the mid-19th-century men (Dr. Henry Bigelow: “Our craft has, once and for all, been robbed of its terrors”) who discovered or recognized the efficacy of ether and chloroform, and the surgeons who, at first, opposed their use (Alfred Velpeau: “To escape pain in surgical operation is a chimera”).

There are mini-profiles of 21st-century doctors on the frontiers of neurobiology; placebo researchers; and pain specialists who allowed her to sit in on their sessions with patients and interview them afterward. And there are many patients, often eloquent chronic pain sufferers, whose stories complement and contextualize her own.

Although some of them discuss massage and acupuncture, Ms. Thernstrom gives these treatments short shrift and evinces little interest in how Eastern medicine addresses pain. Nor does she provide a judicious evaluation of psychotherapy; she refers to an early “psychoanalysis session, ” and doesn’t return to the subject. Physical therapy reminds her of dating: “small, futile-feeling gestures that require faith to believe they will eventually lead you somewhere.”

But memoir is a subjective form that chooses its own territory and doesn’t claim to cover all the bases. What counts is the narrator’s voice, interests and sensibility. Melanie Thernstrom is such an engaging and intelligent writer that I remained intrigued with her investigation even as I disagreed with some of her reportorial choices. I cheered as she disentangled romantic from physical pain and found a caring partner. I was dismayed to discover that she found no remedy and that, for the time being, she and millions of others will continue to suffer from chronic pain.

Helen Epstein, the author of six books of nonfiction, writes a blog for the New England arts Web site theartsfuse.com.

http://www.nytimes.com/2010/08/20/books/20book.html?ref=health

When Doctors Admit Their Mistakes

By PAULINE W. CHEN, M.D.

One afternoon, I overheard a nurse asking another physician how she was feeling. The physician, a young woman known throughout the hospital for her cheery disposition and sunny bedside manner, looked ashen. She smiled weakly in response and insisted that nothing was wrong.

“She’s lying,” the nurse whispered to me as the doctor walked away. “She’s upset because risk management wouldn’t let her go to that patient’s funeral.”

That the optimistic young physician would grieve following a patient’s death hardly surprised anyone. We had all seen her go through the death of a patient before: she worked in a specialty where such loss was relatively common, yet she fearlessly continued to develop deep relationships with those she cared for. However, as the nurse so perceptively noted that afternoon, what was more difficult for her to bear this time was not the loss but the constraint imposed on the relationship afterward.

Her patient had died in the hospital a week earlier. In conversations in the hallways and clinics, other doctors and nurses combed through the facts of the event hoping to find some detail — a physiological oddity, an honest misunderstanding, even an error — that could help prevent the same thing from happening to our patients in the future.

But then rumors that the family was considering a lawsuit began to make the rounds. Soon afterward, administrators from risk management, the department of the hospital devoted to improving safety, began warning us not to talk about the case — not to one another, not to the news media and, most of all, not to the family. It was not hard to understand why under this new order of silence attending a patient’s funeral might be discouraged.

Several weeks later, I ran into my colleague once more and asked if she had heard anything about the patient's family. "Yes," she said lowering her voice. She pulled me over to a quiet end of the hallway and recounted a recent phone conversation with the patient's mother. Then she took a deep breath and began grinning broadly. "I know the hospital and the lawyers and the other doctors might disagree with what I did, but I had to talk to the family," she said. "I just couldn't abandon them."

Despite the best efforts of health care professionals, bad things can happen in hospitals. Up until more recently, when errors occurred, the scenario that played out was always the same. Clinicians, devastated but fearful of litigation, would shut down. Patients and their families, grieving but desperate to make sense of the event, would find that their doctors and nurses were no longer responsive or available. Eventually, the most important relationship in health care, that between patient and doctor, would cede to the most adversarial one, that between plaintiff and defendant.

In the late 1980s, one hospital system, the Veterans Affairs Medical Center in Lexington, Ky., decided to try another approach to medical mistakes. Doctors there eventually published a paper describing their "humanistic risk management policy." It included early review of the events that took place, full disclosure to patients of accidents or errors, fair compensation for injuries and ongoing attention to the relationship between clinicians and patients. And it appeared to decrease liability claims and costs.

Encouraged by these early results and by emerging data linking open disclosure with patient satisfaction, quality of care and improved overall safety, a few other intrepid health care systems across the country began to experiment with similar programs.

Few at the time could argue against the benefits to patients of open disclosure. But in the years since, one question has remained: are these policies also beneficial to physicians, many of whom are already struggling just to get their work done?

According to a study released this week in The Annals of Internal Medicine and the experience of one of the early-adopter institutions, the answer appears to be yes.

Since 2001, the University of Michigan Health System has handled patient injuries by initiating discussions with patients and families, conducting internal investigations and offering apologies with offers of compensation should those investigations reveal medical errors. To examine the repercussions of such an open disclosure with compensation policy, researchers analyzed the number of claims and lawsuits filed against the hospital system between 1995 and 2007, comparing data from before and after the policy took effect.

Contrary to fears that such transparency might worsen litigation, the researchers found that there were actually fewer lawsuits and claims after the hospital began its disclosure with compensation program. Moreover, the hospital system's liability costs for lawsuits, patient compensation and legal fees dropped, and claims in general were resolved faster than ever before.

"Everybody worries that disclosure will lead to liability going through the roof," said Dr. Allen Kachalia, lead author and an assistant professor of medicine at Harvard Medical School. "But here's one institution that set up their disclosure program privately and independently, helped their patients avoid using the courts and tort system, and did not sustain the skyrocketing claims and costs that others might have predicted."

The disclosure process at Michigan involves a series of meetings that take anywhere from a few weeks to more than a year to complete. Doctors, other involved clinicians and members of the hospital's risk management department meet with the patient and family members to explain the events, offer assurances that the investigation will be timely and thorough, and promise that all will be done to prevent such a mistake from ever occurring again. While not all of the injuries investigated are due to errors, those that are result in compensation ranging from a simple formal apology to a check, mortgage payments and funding for named lectureships and memorials.

"When you break that paradigm of litigation and give patients the chance to understand the human element of the other side — of the doctor and what they are struggling with — you find that people are far more forgiving and understanding than has been typically assumed," said Richard C. Boothman, one of the study's authors and the medical center's chief risk officer, who devised and carried out the disclosure program. "We have given patients no alternative but to sue, and then we use the fact that they sue to show how opportunistic and awful they are."

While the study documents the financial bottom line, Mr. Boothman notes that there have been perhaps even more significant repercussions in the culture of the institution. When the program first started, for example, a majority of injury reports came from patient lawyers. "Today more than 75 percent of the time we learn of an incident from the clinicians or from the patients themselves almost as soon as it happens," Mr. Boothman said.

That openness has in turn created an environment where patient safety and patient care, not avoidance of litigation, have become the priority.

"All this program does is give permission to doctors and other caregivers to do what's important and what they want to do — take care of the patients and make sure the same error doesn't ever happen again in the future," Mr. Boothman said.

The study authors acknowledge that more research needs to be done examining the effect of disclosure with compensation policies on health care settings other than large academic medical centers like their own. Nonetheless, they believe that their experience has shown that openly discussing, admitting and even apologizing for medical errors is important not only for patients but also for doctors and the doctor-patient relationship itself.

"Everyone loathes litigation, but it's the only alternative we've ever given anybody," Mr. Boothman said. "Something is wrong if the only way we can address medical errors prevents human beings from understanding one another."

He added: "There has to be an appreciation across the board that we are all in this together."

http://www.nytimes.com/2010/08/19/health/19chen.html?ref=health

Christians and Muslims

By LINDA ROBINSON

THE TENTH PARALLEL

Dispatches From the Fault Line Between Christianity and Islam

By Eliza Griswold

317 pp. Farrar, Straus & Giroux. $27

The influential political scientist Samuel P. Huntington theorized about the "clash of civilizations." The journalist and poet Eliza Griswold takes on the same topic in a much more visceral way: she traveled through the "torrid zone" to see, smell, taste and write about it. Her book "The Tenth Parallel" is a fascinating journey along the latitude line in Africa and Asia where Christianity and Islam often meet and clash. Since Americans commonly equate Islam with the Arab Middle East, this book is a useful reminder that four-fifths of Muslims live elsewhere. It's also an intimate introduction to some of those who live in places like Nigeria, Sudan, Somalia, Indonesia, Malaysia and the Philippines.

"The Tenth Parallel" is a beautifully written book, full of arresting stories woven around a provocative issue — whether fundamentalism leads to violence — which Griswold investigates through individual lives rather than caricatures or abstractions. In this tropical region where monsoons and jungles give way to desert, she

looks at how history, resources, climate and demographic trends have combined with and shaped the struggle among religions. Because of both population growth and the explosion of Christianity in Africa in the last half-century, nearly a fourth of the world's Christians now live south of the 10th parallel, alongside Muslims who are migrating from the north to escape creeping desertification. All along this fault line, struggles over valuable resources like oil, lumber and minerals add to the volatile mix.

Africa is a logical place for Griswold to begin her story, since Muhammad sent followers and family to find refuge in Christian-ruled Abyssinia (modern-day Ethiopia) in 615. Traders have plied the route from Mecca to Timbuktu in western Africa ever since. Nigeria is Africa's most populous country, and its 140 million people are evenly divided between the Muslim north and the Christian south. It is also America's fifth-largest supplier of oil. Chronic conflict springs from both these sources. Griswold visited a local Muslim king, the emir of Wase, in his hilltop castle in 2006 to hear him bemoan the worsening outbreaks of religious violence — which had taken tens of thousands of lives — that neither his clout as a traditional leader nor his Ph.D. from the University of Pittsburgh could halt.

Griswold's journey is made all the more interesting because of her personal motivations. The daughter of a leading liberal Episcopal bishop, she recalls being spooked by the consecration ceremony in which he lay facedown on the floor of the cathedral in Chicago with his legs and arms stretched out in the shape of a cross. As a young girl she saw the Bible "as a book of spells, one whose extravagant metaphors, whose terrible and powerful parables were ways to call God down to earth." And as a teenager she feared that God would ask her to be a nun. "I spent those years wondering how it was that smart people could believe in God," she writes.

In 2003 Griswold traveled to Sudan with Billy Graham's son Franklin, who attempted to convert her by inviting her to pray with him. She could not find a logical reason to decline, since, as a good ecumenical Episcopalian, she had prayed with Sunnis and Sufi Muslims. She returned to Sudan five years later, after its leader was indicted by the International Criminal Court for genocide. The war-torn country's Christian south is preparing for a 2011 vote on whether to split from the Muslim north, which would break Africa's largest country in half. Griswold also reports from Somalia at great personal risk, vividly describing in 30 pages the religious violence and ill-informed policies that America has pursued since its failed attempts to corral the murderous Aidid clan (members of which she meets with). More recently, Washington has been trying to weaken the Qaeda-linked Shabab gang and shore up a hapless Islamist government.

In Indonesia, home to the world's largest Muslim population, the religious ferment mostly occurs between conservative and moderate Islam. Bouts of violence shocked the quiescent majority into defending a traditionally tranquil version of its faith and, happily, the moderates may now have the upper hand. Griswold trekked from Jakarta to the province of Aceh, meeting all sorts of Indonesians, from a terrorist leader to a bride-to-be worried she would be found not to be a virgin. Those unfamiliar with Asia may be surprised to learn that a much more draconian legal system defends and promotes Islam in tiny, prosperous Malaysia, whose oil wealth and skyscrapers coexist with measures that ban usury and ensure compliance with Shariah or Islamic law; make it illegal for a Muslim to leave the faith and forbid proselytizing by other religions — all to preserve the Malay culture and Muslim religion in this melting pot of Hindus, Buddhists, Christians and aboriginal tribes like the Orang Asli, who practice animism.

"The Tenth Parallel" ends in the Philippines, the only Christian country in Asia. Nine of 10 Filipinos practice the religion Ferdinand Magellan brought to the archipelago in 1521. But the Moros, as Magellan termed the Muslims he found there, still populate the southern islands, which Griswold visited to see the local points of conflict. These date back to the start of the 20th century, when Christian Filipinos moved south and fought the

rebellious locals. They were encouraged by the neocolonial power, the United States, whose president, William McKinley, was an evangelizing Methodist.

The Abu Sayyaf of the southern Philippines, like the extremist Jemaah Islamiyah movement in Indonesia, was first radicalized by conflicts in the Balkans and Afghanistan, where militants went to earn their battle stripes. Among the loose global federation of radical Islamists, Abu Sayyaf earned a reputation for thievery, kidnapping and other common crimes. It was during one such crime spree that the group kidnapped the missionaries Martin and Gracia Burnham. Their yearlong ordeal as hostages wasting away in the jungle ended in tragedy when Gracia was rescued but Martin was killed; it was the Philippine Army's 17th attempt to free them. Gracia, whom Griswold interviewed, was remarkably generous toward her captors, understanding the role that poverty has played in their lives. "Jihad was a 'career move,' she said. The only other job besides kidnapping was fishing. And fishing required a boat." Gracia, who had lived among the impoverished people of the developing world for most of her adult life, felt more at home in places like the Philippines than the Kansas heartland where she settled after Martin's death.

The same might be said of the itinerant and intrepid author, who candidly admits that she has discovered no neat theory to explain why people fight over religion or why someone like the self-proclaimed Reverend Abdu, a former Muslim Fulani nomad, lives his life as an unpaid proselytizer or why a missionary couple in the Sudan persist although they have not converted a single soul. Sitting in Abdu's sweltering hut one day Griswold experienced the paradoxically cooling effect of the hot tea he serves her and realizes that some mysteries cannot be solved.

Linda Robinson's most recent book is "Tell Me How This Ends: General David Petraeus and the Search for a Way Out of Iraq."

http://www.nytimes.com/2010/08/22/books/review/Robinson-t.html?nl=books&emc=booksupdateema1

Deaf Students Test Sign Language on Smartphones

- By Priya Ganapati
- August 17, 2010 |

For most people, video chat on cellphones is a fun application. But for some users, video chat could make a huge difference to their quality of life.

Engineers at the University of Washington have developed a system that helps deaf and hearing-challenged users communicate using video chat efficiently and at low cost over 3G networks. With video chat, they can use American Sign Language, just as they do in face-to-face conversations.

“The point is to provide real-time video cellular communication for deaf people,” says Jessica Tran, a doctoral student at University of Washington, who worked on the mobile ASL project with Eve Riskin, a professor of electrical engineering at the school. “We are able to send video over both 3G and Wi-Fi networks at a very low bit rate.”

The first phase of testing of the device, which started late last month, will end on Wednesday.

Phones imported from Europe are being used to test the software. But mobile ASL can potentially run on any device.

So far, hearing-challenged consumers have used video chat on PCs. For mobile phones, they must send text messages. But that can be limiting because it doesn't convey emotions, voice inflections or body language.

The iPhone 4, HTC Evo and Samsung's Epic 4G phone have front-facing cameras for videoconferencing.

But video chat on these devices can be too much of a bandwidth hog. The iPhone's FaceTime video conferencing service uses nearly 10 times the bandwidth of mobile ASL, say the researchers.

As a result, carriers often impose restrictions on video chat over their networks, limiting the feature to Wi-Fi network connections.

Specially designed software that allows video chat through cellphones, without taking up a lot of bandwidth, could change that.

"Mobile ASL is pretty cool," says Josiah Cheslik who has tried the new device. "It is just like when people would just pick up phone and call someone else. And it is is more speedy than texting or e-mail."

The latest smartphones have introduced already video chat over mobile networks to consumers.

For mobile ASL, researchers have found a way to optimize compressed video signals. By increasing image quality around the face and hands, they have brought the data rate down to 30 kilobytes per second. Mobile ASL also uses motion detection to identify whether a person is signing or not so it can help extend the phone's battery life during video use.

Tran says when researchers started working on the project, about five years ago, phones with front-facing cameras weren't available in the U.S. So they imported phones from Europe. But as smartphones in the U.S. get more powerful and begin including front-facing cameras, the project might find ways to make its software compatible with existing devices.

For now, mobile ASL can run only on phones running Windows Mobile operating system, but the team hopes to port it to Android.

Photos:Mary Levin/University of Washington

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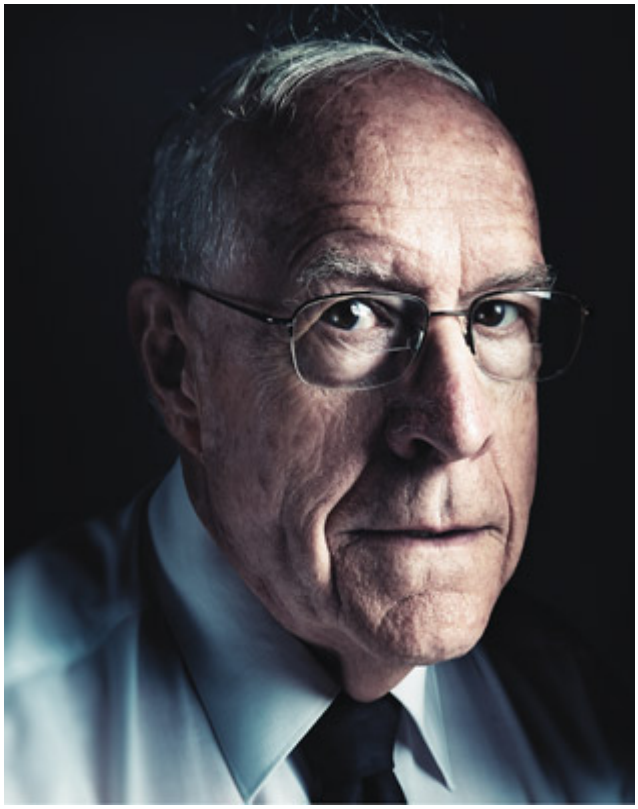
Master Planner: Fred Brooks Shows How to Design Anything

- By Kevin Kelly
- July 28, 2010 |



We might think that the limiting factor on many design projects is money, Brooks says, but that's not true. Photo: Marco Grob

You can't accelerate a nine-month pregnancy by hiring nine pregnant women for a month. Likewise, says University of North Carolina computer scientist Fred Brooks, you can't always speed up an overdue software project by adding more programmers; beyond a certain point, doing so increases delays. Brooks codified that precept 35 years ago in a small technical book, *The Mythical Man-Month*, which he named after the flawed assumption that more manpower meant predictably faster progress. Today, his insight is known as Brooks' law. The book still sells 10,000 copies a year, and Brooks—who oversaw the creation of IBM's System/360, the company's most successful mainframe—is hailed as a legend. Now he's written a new book, *The Design of Design*. It's a collection of essays that extends his ideas into the fields of architecture, hardware systems, and leadership. *Wired*'s founding executive editor, Kevin Kelly, spoke with Brooks to discuss the upside of failure, lowercase letters, and what we can learn from Apple.

***Wired*:** How does a guy who grew up in the 1940s among North Carolina tobacco farmers get into computers?

Fred Brooks: I collected maps as a kid. I had tried all kinds of ways to index my map collection, which got me interested in the notion of automatic data retrieval. In 1944, when I was 13, I read about the Harvard Mark 1 computer in a magazine, and I knew then that computers was what I wanted to do.

***Wired*:** When you finally got your hands on a computer in the 1950s, what did you do with it?

Brooks: In our first year of graduate school, a friend and I wrote a program to compose tunes. The only large sample of tunes we had access to was hymns, so we started generating common-meter hymns. They were good enough that we could have palmed them off to any choir.

***Wired*:** Did you imagine all the other things computers would do?

Brooks: Oh, no. Back then computers were mostly for scientific computation, like calculating the orbits of rockets.

***Wired*:** So were you surprised by the advent of personal computers?

Brooks: I was chiefly surprised that they could become so cheap. I didn't know a single person in the computer industry who believed, five years before it happened, that we could sell hundreds of millions of computers a year.

***Wired*:** What provoked you to write *The Mythical Man-Month*?

Brooks: As I was leaving IBM, Thomas Watson Jr. asked me, "You've run the hardware part of the IBM 360, and you've run the software part; what's the difference between running the two?" I told him that was too hard a question for an instant answer but that I would think about it. My answer was *The Mythical Man-Month*.

***Wired*:** Did you ever expect it to be read by nonprogrammers?

Brooks: No, and I've been surprised that people still find it relevant 35 years later. That means we still have the same problems.

***Wired*:** What do you consider your greatest technological achievement?

Brooks: The most important single decision I ever made was to change the IBM 360 series from a 6-bit byte to an 8-bit byte, thereby enabling the use of lowercase letters. That change propagated everywhere.

***Wired*:** You say that the Job Control Language you developed for the IBM 360 OS was "the worst computer programming language ever devised by anybody, anywhere." Have you always been so frank with yourself?

Brooks: You can learn more from failure than success. In failure you're forced to find out what part did not work. But in success you can believe everything you did was great, when in fact some parts may not have worked at all. Failure forces you to face reality.

***Wired*:** In your experience, what's the best process for design?

Brooks: Great design does not come from great processes; it comes from great designers.

***Wired*:** But surely *The Design of Design* is about creating better processes for great designers?

Brooks: The critical thing about the design process is to identify your scarcest resource. Despite what you may think, that very often is not money. For example, in a NASA moon shot, money is abundant but lightness is scarce; every ounce of weight requires tons of material below. On the design of a beach vacation home, the limitation may be your ocean-front footage. You have to make sure your whole team understands what scarce resource you're optimizing.

***Wired*:** How has your thinking about design changed over the past decades?

Brooks: When I first wrote *The Mythical Man-Month* in 1975, I counseled programmers to "throw the first version away," then build a second one. By the 20th-anniversary edition, I realized that constant incremental iteration is a far sounder approach. You build a quick prototype and get it in front of users to see what they do with it. You will always be surprised.

***Wired*:** You're a Mac user. What have you learned from the design of Apple products?

Brooks: Edwin Land, inventor of the Polaroid camera, once said that his method of design was to start with a vision of what you want and then, one by one, remove the technical obstacles until you have it. I think that's what Steve Jobs does. He starts with a vision rather than a list of features.

***Wired*:** In the past few decades, we've seen remarkable performance improvements in most technologies—but not in software. Why is software the exception?

Brooks: Software is *not* the exception; hardware is the exception. No technology in history has had the kind of rapid cost/performance gains that computer hardware has enjoyed. Progress in software is more like progress in automobiles or airplanes: We see steady gains, but they're incremental.

***Wired*:** You've been involved in software for over 50 years. Can you imagine what software will be like 50 years from now?

Brooks: Nope. All of my past predictions have been, shall we say, short-sighted. For instance, I once argued that every member of a team should be able to see the code of every other member, but it turns out that encapsulation works much better.

***Wired*:** Do you have any advice for young industrial designers and software architects?

Brooks: Design, design, and design; and seek knowledgeable criticism.

Kevin Kelly (kk@kk.org) *wrote about the socialistic aspects of digital culture in issue 17.06.*

http://www.wired.com/magazine/2010/07/ff_fred_brooks/

Sci-Fi Vistas Milked From Boring Old Earth

- By Pete Brook
- August 17, 2010 |

For the last ten-plus years, Allison Davies traveled the world alone, stalking unfamiliar landscapes. The resultant series *Outerland* – recently published by Charles Lane Press – is a welcome mixture of art and sci-fi; Davies mysteriously and deliberately omits locations and words to create an alternate world from the scraps of this one.

The photographer is no stranger to mystery and intrigue. The shots for this collection were taken between intermittent assignments as an undercover private investigator for a Manhattan law firm. Iceland and Argentina are known locations, but as for the rest? Death Valley, Chile, Bolivia, New Mexico, Eastern Oregon?

Occasionally Davies steps out into the alien vistas donning a spacesuit of her own design, but for the most part the photos are seeds for the viewers' fantasies of distant worlds.

"Like the conquering expeditionary photographs of the 19th century, we are in alien terrain, free of history, culture and memories," writes Freddy Langer for the popular German newspaper, *The Frankfurter Allgemeine Zeitung*. Langer has been drawn in deep to *Outerland*'s sinister Romanticism. "They do not invite the viewer

to feel good. Rather, they espouse a delicate approach to these new lands, and a warning to scan them cautiously. It is a double-bladed invitation."

Davies began the work for *Outerland* in 1998 as an Yale MFA student under the tutelage of Gregory Crewdson. According to James Danziger, renowned NYC gallerist and photo editor, Davies' photos inspired the title for "Another Girl, Another Planet," Crewdson's seminal 1999 curated exhibition of female photographers working with constructed narratives. The show launched the careers of her classmates, Taryn Simon, Katy Grannan and others, yet for Davies, what followed was the slow continuation of her a solo-planetary mission.

Is Davies an eco-warrior? Is this a portent of barren times – the aftermath of apocalyptic climate-change? Or is she envisioning a post Space-wars Earth? Could this be a world ravaged by chemical and biological agents – the spacer-loner sporting a bio-suit, not a space suit? Personally, we'd like some more (or any) concrete details, but letting the imaginations run wild is part of the appeal.

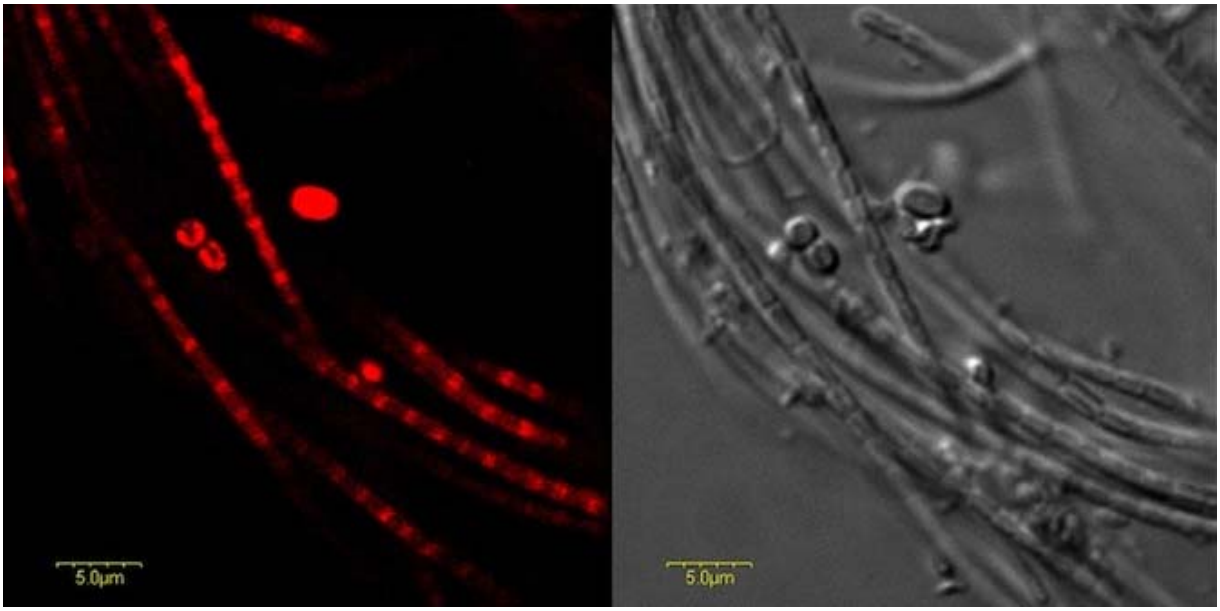
Outerland is the second title by Charles Lane Press, an independent publishing house with a focus on contemporary photography. Charles Lane Press was founded in 2008 by photographer Richard Renaldi and his partner Seth Boyd.

Read More http://www.wired.com/rawfile/2010/08/sci-fi-vistas-milked-from-boring-old-earth/#ixzz0xSXi7BIU

http://www.wired.com/rawfile/2010/08/sci-fi-vistas-milked-from-boring-old-earth/

Newly Discovered Chlorophyll Catches Infrared Light

- By Rachel Ehrenberg, Science News
- August 20, 2010 |



A new kind of chlorophyll that catches sunlight from just beyond the red end of the visible light spectrum has been discovered. The new pigment extends the known range of light that is usable by most photosynthetic organisms. Harnessing this pigment's power could lead to biofuel-generating algae that are super-efficient, using a greater spread of sunlight than thought possible.

"This is a very important new development, and is the first new type of chlorophyll discovered in an oxygenic organism in 60 years," says biological chemist Robert Blankenship of Washington University in St. Louis.

The newfound pigment, dubbed chlorophyll f, absorbs light most efficiently at a wavelength around 706 nanometers, just beyond the red end of the visible spectrum, researchers report online August 19 in *Science*. This unique absorbance appears to occur thanks to a chemical decoration known as a formyl group on the chlorophyll's carbon number two. That chemical tweak probably allows the algaelike organism that makes chlorophyll f to conduct photosynthesis while living beneath other photosynthesizers that capture all the other usable light.

"In nature this very small modification of the pigment happens, and then the organism can use this unique light," says molecular biologist Min Chen of the University of Sydney in Australia. Chen and her colleagues identified the new pigment in extracts from ground-up stromatolites, the knobby chunks of rock and algae that can form in shallow waters. The samples were collected in the Hamelin pool in western Australia's Shark Bay, the world's most diverse stromatolite trove.

Previously there were four known chlorophylls made by plants and other photosynthesizing organisms that generate oxygen: a, b, c and d. Chlorophyll a, the standard green type, is found in photosynthesizers from algae to higher plants. It absorbs mostly blue light around 465 nanometers and red light around 665 nanometers (it reflects green light, hence plants look green). Chlorophylls b and c are found in fewer organisms and absorb light in a similar range as chlorophyll a does, but shifted a bit. Chlorophyll d, found in a specific group of cyanobacteria, absorbs the most light at roughly 697 nanometers, a slightly shorter wavelength than the absorption of the new chlorophyll.

While some bacteria make chlorophyll-like pigments that absorb even longer wavelengths of light, these creatures aren't harnessing light to split water, the step in photosynthesis that generates oxygen. Scientists didn't think that wavelengths absorbed by chlorophyll f would have enough oomph to split water either, but it turns out they do, says Chen.

"This challenges our conception of the limit of oxygenic photosynthesis," she says.

The find may also enable scientists to engineer algae that are more efficient producers of oil for biofuels, says algae biologist Krishna Niyogi of the University of California, Berkeley. Microbes bearing the new chlorophyll could soak up rays that most microbes can't make use of.

There is still much to be learned about the new type of chlorophyll and the organisms that make it, Niyogi says. Chlorophyll f was extracted from the ground-up stromatolites along with a lot of chlorophyll a. It isn't clear what creature was making chlorophyll f, but evidence points to a filamentous cyanobacterium. This cyanobacterium might use both chlorophylls, or perhaps just f.

Read More http://www.wired.com/wiredscience/2010/08/infrared-chlorophyl/#ixzz0xSYJBW3Z

http://www.wired.com/wiredscience/2010/08/infrared-chlorophyl/

Galactic Supervolcano Erupts From Black Hole

- By Lisa Grossman
- August 20, 2010 |

Volcanic eruptions can wreak as much havoc in space as on Earth, a new image of galaxy M87 reveals. The black hole at the galaxy's center is spewing gas and energetic particles in what researchers call a "galactic supervolcano," and suppressing the formation of hundreds of millions of new stars.

The new photo shows clouds of gas that glow in X-ray light (blue) surrounding the galaxy from observations taken by the Chandra X-ray Observatory, and jets of radio emission (red) from observations from the Very Large Array of radio telescopes in New Mexico. Under normal circumstances, the hot gas would cool and fall toward the galaxy's center, ultimately congealing and igniting the birth of new stars.

But in M87, which lies about 50 million light-years away, jets of energetic particles produced by the galaxy's central black hole suppress the formation of new stars. The jets lift up the cooler gas near the center of the galaxy at supersonic speeds, producing shock waves in the galaxy's atmosphere. These plumes of gas contain as much mass as all the gas within 12,000 light-years of the center of the galaxy cluster M87 belongs to. All that gas could have turned into hundreds of millions of stars if the cosmic volcano had given it a chance, researchers say.

The researchers compare the galactic volcano in M87 to the Icelandic volcano Eyjafjallajokull, whose eruption this spring choked the sky with great clouds of ash and grounded planes across Europe. Eyjafjallajokull's eruption pushed pockets of hot gas through the surface lava, also producing shock waves that could be seen in the volcano's smoke. The hot gas then rose up in the atmosphere and dragged cool, dark ash with it, much like the energetic jets produced in the black hole lift cooler gas away from the galactic center.

"This analogy shows that even though astronomical phenomena can occur in exotic settings and over vast scales, the physics can be very similar to events on Earth," Stanford astrophysicist Aurora Simionescu, coauthor of a new study describing the cosmic eruption, said in a press release.

The analogy only goes so far, though. Evan Million, a grad student at Stanford and lead author of another study of M87's volcanic nature, points out that losing millions of stars' worth of gas "seems like a much worse disruption than what the airline companies on Earth had to put up with earlier this year."

Read More http://www.wired.com/wiredscience/2010/08/galactic-volcano/#ixzz0xSYjJQWH

Add salt as required: the recipe for fresh water

- Updated 17:29 20 August 2010 by **Kate Ravilious**
- Magazine issue 2773.

Switching direction could mean an end to water shortages (Image: JOSE LUIS ROCA/AFP/Getty)

Using desalination to slake the world's thirst has been an uphill struggle, but now we're learning to go with the flow

STROLLING along Williamsons beach, a quiet strip of sand about 100 kilometres south-east of Melbourne, Australia, you would never guess that a monster lurks just behind the dunes. Nestled at the bottom of a 27-metre-deep pit is a 500-tonne mechanical giant that is about to begin burrowing under the beach and out to sea. In its wake the machine will leave a 4-metre-wide, 1.5-kilometre-long tunnel, the inlet for one of the world's largest plants to turn seawater into drinking water.

Australia is turning to desalination as fresh water in many parts of the country runs short following years of drought. It is not alone. Many countries are eyeing the oceans as a potential source of drinking water as populations grow and rainfall patterns change. Even the relatively rain-drenched UK now has its first large-scale desalination plant, opened earlier this year on the river Thames in east London.

Even the relatively rain-drenched UK has its first large-scale desalination plant, opened earlier this year on the river Thames in east London

Today's desalination plants are unlikely to solve our looming water crisis, however. That's because they have their own unquenchable thirst- for energy. It's needed to drive reverse osmosis (RO), the process in which salty water is forced at high pressure through a membrane that lets water molecules through but blocks the salt. But now a number of researchers and start-up companies think they have a more energy-efficient alternative, and it works by turning RO desalination on its head.

Any breakthrough would come not a moment too soon. A 2006 UN report estimates that by 2025, 2 out of 3 people could be living under conditions of water stress. Even the US may not be immune: the country is guzzling groundwater around 25 per cent faster than it can be replenished.
Modern RO desalination plants, like the one being built outside Melbourne by water treatment company Suez Environnement, use a fraction of the energy required by the original facilities of this type, constructed in the 1960s. Still, the Melbourne plant will consume at least 90 megawatts of electrical power- roughly the peak output of 20 large off-shore wind turbines- to produce 150 billion litres of water per year. That is because RO is an inherently energy-intensive process: left to its own devices, water flows from a dilute solution into a salty one, whereas RO forces water to do the opposite.

Quick draw

So instead of fighting this energy gradient, why not try to harness it? That's the thinking behind the experimental "forward osmosis" plants that are starting to appear. Water can be sucked effortlessly out of seawater if you offer it a more concentrated "draw solution" to flow into. At first sight that might not appear to achieve anything, but if you are clever about what you use in the draw solution, you can get pure water out at the end.
One of the first companies to harness the power of forward osmosis is Hydration Technology Innovations (HTI), based in Albany, Oregon. In 2004 it released the X-pack, a portable water filter that incorporates a forward osmosis membrane into a small sealed plastic packet. Inside the packet is a powder containing sugar and flavourings, which acts as a seed for the draw solution. "It can be thrown into a muddy puddle and the sugar powder will draw the water molecules through the membrane to create a drink," says Walt Schultz, HTI's chief executive.
Many US soldiers now carry these packs, which can also be chucked over the side of a boat to pull a sweet drink out of the sea. The packs have also been supplied in relief aid following disasters such as the Haiti earthquake this year. But the X-pack is not going to solve the world's water crisis. "Our hydration products are intended for emergency use," says Schultz. "It is a relatively expensive way of producing a clean drink."
In the same year that HTI launched the X-pack, a team at Yale University hit on an idea that took the concept a step forward. Menachem Elimelech, Jeffrey McCutcheon and Robert McGinnis decided to use a draw solution based on ammonium bicarbonate (Desalination, vol 174, p 1). Just as HTI's sugary powder does, the ammonium and bicarbonate ions can pull water through the membrane. If you then heat the solution to around 40 °C, ammonia and carbon dioxide are given off, leaving behind pure water. The gases can be captured and reused, and the team says its method could produce fresh water while using only 20 per cent of the energy of today's desalination plants. That figure assumes, however, that waste heat from power stations is available to drive off the gases, which will limit where such plants can be sited.
Forward osmosis could produce fresh water while using only 20 per cent of the energy of today's desalination plants.
Another challenge is finding a suitable membrane- one permeable to water but impermeable to salts. "It is the main hurdle for the forward osmosis industry," says Tom Pankratz, editor of the *Water Desalination Report* newsletter, based in Houston, Texas. The membrane needs to be as thin as possible to keep the salt water close to the draw solution and so maintain a high osmotic pressure, but robust enough to cope with the flow of water that results.
HTI has developed a cellulose-based membrane for its hydration packs and other products. However, this membrane cannot withstand the alkalinity of Elimelech's ammonium bicarbonate solution. Conventional RO membranes are also unsuitable. These structures need a strong "support layer" to reinforce the membrane against the high pressures of RO, making them too thick for forward osmosis.
Nevertheless, Elimelech and colleagues realised that taking away the thick support layer could leave you with a workable forward osmosis membrane. By experimenting with different polymer solutions, the team came up with a recipe for fabricating a membrane with a replacement support layer, which is thin yet strong and porous. In tests, the new membrane was shown to have nine times the throughput of a conventional RO membrane while keeping out over 97 per cent of the salt (*Environmental Science and Technology*, vol 44, p

3812). The tests were done on a "hand-made lab version" of the new membrane, and "the performance should become even better if the membrane is produced on an industrial scale", Elimelech claims.
McGinnis now works for Oasys, a company based in Cambridge, Massachusetts, which is testing the new membrane and other potential candidates with ammonium bicarbonate as the draw solution. By the middle of next year Oasys hopes to have built a small demonstration plant. "The companies we are working with have waste heat which we can use in the process," says Oasys spokeswoman Lisa Sorgini.
Elimelech's membrane is not the only one undergoing trials. Wang Rong, deputy director of the Singapore Membrane Technology Centre at Nanyang Technological University in Singapore, and her team have recently developed a membrane consisting of tiny tubular fibres which can be used with ammonium bicarbonate as the draw solution (*Journal of Membrane Science*, vol 355, p 158). Salt water passes down the centre of the fibres while the draw solution swills around the outside. Wang says this type of membrane has the potential to reduce the energy used for seawater desalination by at least 30 per cent. Tony Fane, director of the centre, says that their advantage over flat sheet membranes is that it should be easy to produce modules containing thousands of fibres, which can then be assembled as required in a large-scale desalination set-up.
Meanwhile, a UK company called Modern Water, based in Guildford, Surrey, claims to have cracked the membrane problem already and to be successfully deploying forward osmosis to desalinate water, using around 30 per cent less energy than conventional desalination. Instead of ammonium bicarbonate, Modern Water uses a proprietary salt, the name of which the company won't divulge, to suck the water through their membrane. Having used forward osmosis to dilute the draw solution, it then extracts the water by reverse osmosis.

Smashing success

Modern Water's trick is that the molecules used in the draw solution are much larger than the sodium and chloride ions that have to be held back in conventional RO. That means the RO membrane can have larger pores than one to be used with seawater, so less energy is needed to force the water through. Overall, the technique requires much less energy than conventional desalination "because the forward osmosis process has already done much of the hard work", says Adel Sharif of the University of Surrey in Guildford, one of the company's founders. Modern Water says the technology is already in use at a pilot plant in Gibraltar and at a full-scale plant in Oman.
So is forward osmosis the answer to our water needs? For all its potential, there are still hurdles to overcome. Tzahi Cath, a water purification engineer at the Colorado School of Mines in Golden, says Elimelech's concept is sound, but he isn't convinced that waste heat to drive off the ammonium bicarbonate can be obtained cheaply enough to make the process economic. "Low-grade heat is not necessarily available where you need it, and when waste becomes a resource it carries a price tag," he says. The cost of the membranes may also be prohibitive, says Mark Shannon, who directs research into desalination materials at the University of Illinois at Urbana-Champaign. "The water flux in forward osmosis is low, so a lot of membrane is required," he says.
However, both he and Cath see great potential for forward osmosis in recycling waste water, something Oasys is investigating. Being less salty than seawater, waste water yields a much higher water flux because the osmotic gradient is higher, says Shannon.
For the same reason, forward osmosis may also turn out to be ideal for desalinating brackish water, such as deep groundwater and estuary water. Deep groundwater is plentiful. "Underlying almost every continent are large sources of brackish water," Shannon says. "Forward osmosis could be a smashing success."
Kate Ravilious is a science journalist based in York, UK

http://www.newscientist.com/article/mg20727731.400-add-salt-as-required-the-recipe-for-fresh-water.html

Mystery of the Atlantic's missing plastic flotsam

- 19:00 19 August 2010 by **Cian O'Luanaigh**

Deadly mess (Image: 5 Gyres Project)

The amount of floating plastic trapped in a north Atlantic current system hasn't got any bigger in 22 years, despite more and more plastic being thrown away.

Since 1986 students taking samples of plankton in the Atlantic and Caribbean Oceans have also noted when their nets caught plastic debris. Kara Lavender and colleagues at the Sea Education Association in Woods Hole, Massachusetts, analysed the data, and found that of 6136 samples recorded, more than 60 per cent included pieces of plastic, typically just millimetres across. The areas of highest plastic concentration are within the north Atlantic subtropical gyre, where currents gather the debris.

Lavender and her team were surprised to find that the amount of floating plastic had not increased in the gyre. Although it has been illegal since the 1970s for ships to throw plastic overboard, Lavender thinks that the overall rate of plastic rubbish reaching the ocean will have increased, given the fivefold increase in global production of plastic since 1976.

Slipping through the net?

"Where the extra plastic is going is the big mystery," she says. Plastic resists biodegradation and can last decades or more in the ocean. Eventually sunlight and wave motion break it into smaller pieces, which can be harmful to marine life – clogging the stomachs of fish and seabirds, for example.

Law suggests that the plastic might be degrading into pieces small enough to pass through the 0.3-millimetre-mesh nets used in the study, or becoming coated in biofilms and sinking out of range of the nets. However it is unclear why the rate of degradation during the study period should have increased to offset the extra plastic going into the ocean.

She says it is unlikely that ocean currents are pushing plastic out of the gyre, although Simon Boxall of the National Oceanography Centre in Southampton, UK, who wasn't involved in the study, disagrees. He says the Atlantic gyre has an exit strategy in the form of the Gulf Stream. "We've seen high levels of plastic in the Arctic" he says.

Eternal pollution

Wherever it is going at the moment, the plastic on our oceans will eventually be broken down into microscopic pieces and individual molecules whose environmental effect is unknown. "The million-dollar question is, is it causing any damage?" says Boxall.

"When plastic particles get so small are they just like roughage going through the system? Some studies suggest that persistent chemicals in newer plastics function as endocrine disruptors and mimic hormones such as oestrogen."

And this fine-grained plastic is very long-lived. "The depressing thing is it's likely to remain in the oceans essentially forever," says Lavender.

Journal reference: *Science*, DOI: 10.1126/science.1192321

http://www.newscientist.com/article/dn19340-mystery-of-the-atlantics-missing-plastic-flotsam.html

Great Barrier Reef's great-grandmother is unearthed

- 19 August 2010
- Magazine issue 2774.

Age before beauty, when it comes to coral? (Image: Naoi/ Flickr/Getty)

JUST 600 metres away from the Great Barrier Reef, the jewel in Australia's crown, a less spectacular but more ancient reef has been discovered.

The first hint of its existence came in 2007, when seismic and sonar measurements revealed odd ridges and lagoons on the seabed. Confirmation arrived in February this year, when an international team extracted 34 sediment cores from three sites on the seabed, revealing a fossilised coral reef that reaches 110 metres into the sea floor. Preliminary dating of the core indicates that the coral is up to 169,000 years old.

"This is the great-grandmother of the Great Barrier Reef," says John Pandolfi of the University of Queensland, who was not on the mission. It is "a very important discovery", he says, and should provide new insights into the genesis of the reef.

The prevailing wisdom has been that the Great Barrier Reef sits atop an older, dead reef, but 110 metres beneath the live reef, the team hit rock. Corals need light to live, and Pandolfi now thinks that when rising sea levels at the end of the last ice age threatened to put the lights out on the ancient reef, some larvae travelled to shallower waters and seeded the modern one.

The findings were presented by Jody Webster of the University of Sydney at the Integrated Ocean Drilling Program conference in Bremen, Germany, in July.

http://www.newscientist.com/article/mg20727744.000-great-barrier-reefs-greatgrandmother-is-unearthed.html

Stop wasting food, save the world's energy

- 18 August 2010 by **Sheril R. Kirshenbaum** and **Michael E. Webber**

Magazine issue 2773.

It's not just rubbish, it's energy, too (Image: Steve Fricker)

The scandal of food waste is even worse when you consider how much energy is being thrown away, say ***Sheril Kirshenbaum*** *and* ***Michael Webber***

IT IS no secret that meeting the world's growing energy demands will be difficult. So far, most of the focus has been on finding oil in areas that are ever more difficult to access - think BP's Deepwater Horizon well - bringing new fossil fuels such as tar sands online and increasing energy efficiency.

Yet we have been overlooking an easier way. We could save an enormous amount of energy by tackling the huge problem of food waste. Doing so is likely to be quicker than many of the other options on the table, while also saving money and reducing emissions.

The energy footprint of food is enormous. Consider the US, where just 5 per cent of the global population consumes one-fifth of the world's energy. Around 15 per cent of the energy used in the US is swallowed up by food production and distribution. Most of that comes from farming with mechanised equipment, fertilisers and pesticides, irrigation and so on. Then there's the energy cost of sorting, processing and packaging.

On top of that, each item of food on an American plate has made an average trip of over 2400 kilometres by boat, plane, train or automobile. Then there's unloading, stocking grocery stores and meal preparation. By the time all of these steps are accounted for, food takes a significant bite out of the US's total annual energy budget of about 100 million terajoules.

We have to eat, of course, but what about the food that we produce but do not eat?

Between one-quarter and one-third of the food produced in the US gets wasted, for a variety of reasons. A great deal spoils or is discarded before even reaching consumers, on farms, in fisheries and during processing.

Buyers often reject perfectly edible produce because of minor blemishes. Food gets tossed in the trash in the home just because we bought or served too much, or let food spoil. Over a year, the average American family of four spends almost $600 on food that they do not eat.

Between one-quarter and one-third of all the food produced in the US gets wasted

Whatever the reason, food waste has a large cumulative impact. A recent analysis by one of us (Michael Webber) and Amanda Cuéllar at the University of Texas at Austin found that close to 2.2 million terajoules embedded in food waste was discarded in the US in 2007 - the energy equivalent of about 350 million barrels of oil (*Environmental Science & Technology*, DOI: 10.1021/es100310d).

This means that at least 2 per cent of the total US energy budget is literally thrown in the trash. For comparison, 350 million barrels of oil is nearly double Switzerland's total annual energy consumption. Only a small fraction of what is wasted is ever recovered.

Global energy consumption is projected to increase by close to 50 per cent between 2006 and 2030. That makes reducing our dependency on fossil fuels even more challenging.

Tackling food waste should be added to the toolbox of policy options because its relative impact is on the same scale as more popular measures such as biofuel production and offshore drilling. Although we will never eliminate food waste completely, we can assuredly create the means to discard less by coming up with the right incentives for producers and consumers.

The first step involves identifying efficiency savings along the production chain, which might include improved farming practices or more funding for agricultural research. We already have the means to create varieties of vegetables and fruit that spoil more slowly than before, but the approach involves genetic engineering and there is consumer resistance, so public acceptance of new technologies should be encouraged.

Companies can do their bit, too. Hotels are already saving significantly on water and energy by encouraging their guests to use towels more than once. In the same manner, restaurants might reduce food waste by reducing their often profligate portion sizes.

Supermarkets could benefit by selling perfectly edible fruits and vegetables that are currently discarded because of blemishes. Such measures would not only reduce food waste but also save companies money and demonstrate that they are environmentally conscious, which in turn would enhance their reputation and increase their profits.

However, businesses function based on the demands of their customers, so ultimately we need to change people's actions. This will be tricky.

Foremost, the public needs to be better educated about proper storage of foods to keep them edible for longer. Shoppers could be supplied with easy-to-digest, accurate information about the proper shelf life of products, so that they are able to plan meals more carefully and end up with less spoilt food at the end of the week.

Another problem is "use by" dates, which are extremely conservative and can encourage consumers to throw away perfectly edible food. Similarly, "sell by" dates are usually meant as guidelines for retailers to ensure they do not keep stock too long, not as guidance to consumers about when the food will spoil. We need to improve the way we label foods.

Initiatives targeted at consumers could also have ripple-out effects: not only will educating people about food waste reduce pressure on their wallets, it would also lead to fewer trips to the store, saving on gasoline and reducing carbon emissions. Most important, it would help to promote a culture that places a higher value on food, energy, and the way their complex relationship affects us all.

Sheril R. Kirshenbaum is a research associate at the Center for International Energy and Environmental Policy (CIEEP) at the University of Texas at Austin and co-author of Unscientific America: How scientific illiteracy threatens our future (with Chris Mooney).

Michael E. Webber is associate director of CIEEP

http://www.newscientist.com/article/mg20727735.600-stop-wasting-food-save-the-worlds-energy.html

Fatal cloudburst devastates Himalayan desert town

- 15:12 17 August 2010 by **Anil Ananthaswamy**

Leh on 7 August, after a night of flash floods and mud slides (Image: Yawar Nazir/Getty)

Even as the world's attention was focused on the floods in Pakistan, a rare and extreme cloudburst devastated the Himalayan town of Leh in Ladakh, India – normally one of the driest regions on Earth.
Heavy rainfall is common elsewhere in the Himalayas, but not in Ladakh. The region lies in the rain shadow of the high mountains, making it a cold, high-altitude desert. According to the Indian Meteorological Department, Ladakh receives an average of about 15 millimetres of rain during August.
But between 1.30 and 2 am on 6 August, a cloudburst hit Leh. It led to flash floods and mudslides, washing away houses that weren't built to withstand such rainfall. More than 150 people have died and hundreds more are missing.
The rainstorm was so focussed that it missed a nearby weather station, so the total rainfall is not known.

Climate to blame?

Climate models used by the Intergovernmental Panel on Climate Change predict that the number of extreme events such as cloudbursts will increase with rising global temperature, says climate scientist Jayaraman Srinivasan of the Indian Institute of Science in Bangalore.
But he adds that there is not enough evidence to pin the Leh cloudburst on global warming. "The problem with mountainous areas is that we don't have sufficient data," he says. "We only know from hearsay that the number of extreme events has increased over the past few years."

http://www.newscientist.com/article/dn19323-fatal-cloudburst-devastates-himalayan-desert-town.html

Drink Water to Curb Weight Gain? Clinical Trial Confirms Effectiveness of Simple Appetite Control Method

Drinking more water before meals can help promote weight loss, new research suggests. (Credit: iStockphoto/Lise Gagne)

ScienceDaily (Aug. 23, 2010) — Has the long-sought magic potion in society's "battle with the bulge" finally arrived? An appetite-control agent that requires no prescription, has no common side effects, and costs almost nothing? Scientists report results of a new clinical trial confirming that just two 8-ounce glasses of the stuff, taken before meals, enables people to shed pounds. The weight-loss elixir, they told the 240th National Meeting of the American Chemical Society (ACS), is ordinary water.

"We are presenting results of the first randomized controlled intervention trial demonstrating that increased water consumption is an effective weight loss strategy," said Brenda Davy, Ph.D., senior author on the study. "We found in earlier studies that middle aged and older people who drank two cups of water right before eating a meal ate between 75 and 90 fewer calories during that meal. In this recent study, we found that over the course of 12 weeks, dieters who drank water before meals, three times per day, lost about 5 pounds more than dieters who did not increase their water intake."

"People should drink more water and less sugary, high-calorie drinks. It's a simple way to facilitate weight management."

Davy pointed out that folklore and everyday experience long have suggested that water can help promote weight loss. But there has been surprisingly little scientific information on the topic. Previous studies hinted

that drinking water before meals reduces intake of calories. Lacking until now, however, has been the "gold-standard" evidence from a randomized, controlled clinical trial that compares weight loss among dieters who drink water before meals with those who do not.

The study included 48 adults aged 55-75 years, divided into two groups. One group drank 2 cups of water prior to their meals and the other did not. All of the subjects ate a low-calorie diet during the study. Over the course of 12 weeks, water drinkers lost about 15.5 pounds, while the non-water drinkers lost about 11 pounds.

Davy said water may be so effective simply because it fills up the stomach with a substance that has zero calories. People feel fuller as a result, and eat less calorie-containing food during the meal. Increased water consumption may also help people lose weight if they drink it in place of sweetened calorie-containing beverages, said Davy, who is with Virginia Tech in Blacksburg, Va.

Diet soda pop and other beverages with artificial sweeteners may also help people reduce their calorie intake and lose weight, Davy said. However, she advised against using beverages sweetened with sugar and high-fructose corn syrup because they are high in calories. A 12-ounce can of regular soda pop, for instance, contains about 10 teaspoons of sugar.

Davy noted that that nobody knows exactly how much water people should drink daily. The Institute of Medicine, an agency of The National Academies, which advises the Federal Government on science, says that most healthy people can simply let thirst be their guide. It does not specify exact requirements for water, but set general recommendations for women at about 9 cups of fluids -- from all beverages including water -- each day, and men at about 13 cups of fluids.

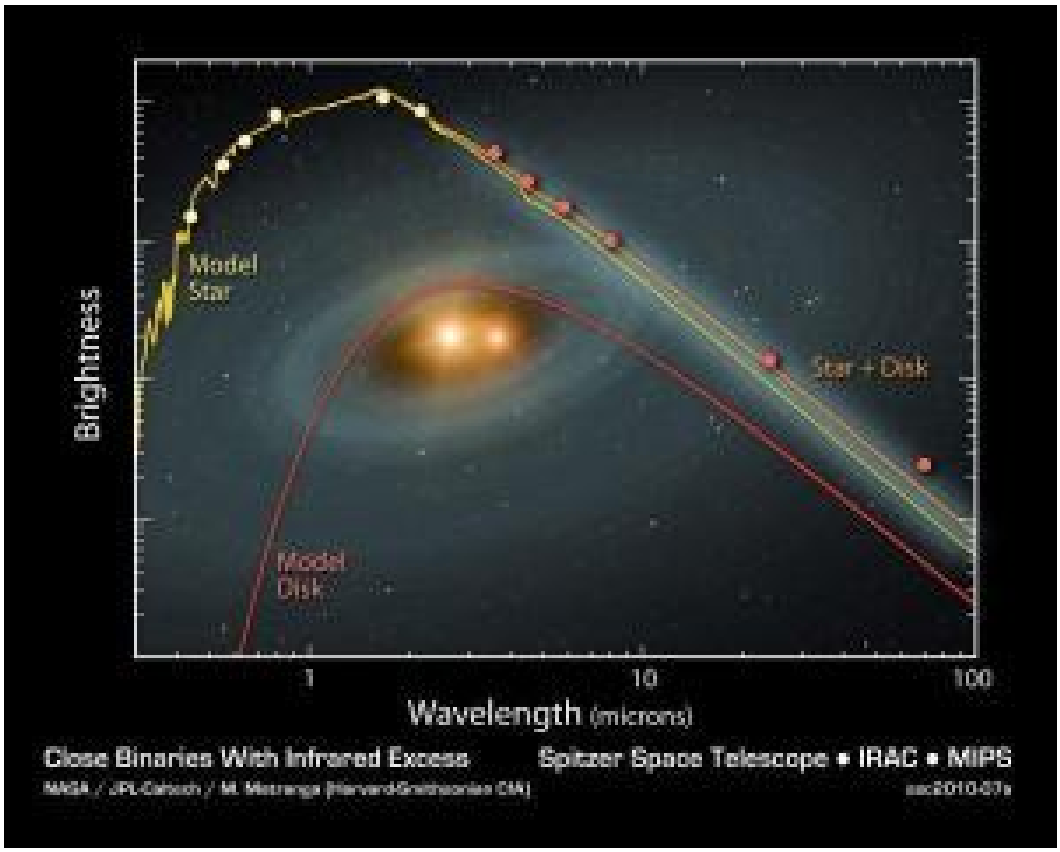
And it is possible to drink too much water, a situation that can lead to a rare, but serious, condition known as water intoxication, Davy pointed out.

Story Source:

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

http://www.sciencedaily.com/releases/2010/08/100823142929.htm

Pulverized Planet Dust May Lie Around Double Stars



This plot of data from NASA's Spitzer Space Telescope tells astronomers that a dusty planetary smashup probably occurred around a pair of tight twin, or binary, stars. (Credit: NASA/JPL-Caltech/Harvard-Smithsonian CfA)

ScienceDaily (Aug. 23, 2010) — Tight double-star systems might not be the best places for life to spring up, according to a new study using data from NASA's Spitzer Space Telescope. The infrared observatory spotted a surprisingly large amount of dust around three mature, close-orbiting star pairs. Where did the dust come from? Astronomers say it might be the aftermath of tremendous planetary collisions.

"This is real-life science fiction," said Jeremy Drake of the Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass. "Our data tell us that planets in these systems might not be so lucky -- collisions could be common. It's theoretically possible that habitable planets could exist around these types of stars, so if there happened to be any life there, it could be doomed."

Drake is the principal investigator of the research, published in the Aug.19 issue of the *Astrophysical Journal Letters*.

The particular class of binary, or double, stars in the study are about as snug as stars get. Named RS Canum Venaticorums, or RS CVns for short, they are separated by only about two-million miles (3.2-million kilometers), or two percent of the distance between Earth and our sun. The stellar pairs orbit around each other every few days, with one face on each star perpetually locked and pointed toward the other.

The close-knit stars are similar to the sun in size and are probably about a billion to a few billion years old -- roughly the age of our sun when life first evolved on Earth. But these stars spin much faster, and, as a result, have powerful magnetic fields, and giant, dark spots. The magnetic activity drives strong stellar winds -- gale-

force versions of the solar wind -- that slow the stars down, pulling the twirling duos closer over time. And this is where the planetary chaos may begin.

As the stars cozy up to each other, their gravitational influences change, and this could cause disturbances to planetary bodies orbiting around both stars. Comets and any planets that may exist in the systems would start jostling about and banging into each other, sometimes in powerful collisions. This includes planets that could theoretically be circling in the double stars' habitable zone, a region where temperatures would allow liquid water to exist. Though no habitable planets have been discovered around any stars beyond our sun at this point in time, tight double-star systems are known to host planets; for example, one system not in the study, called HW Vir, has two gas-giant planets.

"These kinds of systems paint a picture of the late stages in the lives of planetary systems," said Marc Kuchner, a co-author from NASA Goddard Space Flight Center in Greenbelt, Md. "And it's a future that's messy and violent."

Spitzer spotted the infrared glow of hot dusty disks, about the temperature of molten lava, around three such tight binary systems. One of the systems was originally flagged as having a suspicious excess of infrared light in 1983 by the Infrared Astronomical Satellite. In addition, researchers using Spitzer recently found a warm disk of debris around another star that turned out to be a tight binary system.

The astronomy team says that dust normally would have dissipated and blown away from the stars by this mature stage in their lives. They conclude that something -- most likely planetary collisions -- must therefore be kicking up the fresh dust. In addition, because dusty disks have now been found around four, older binary systems, the scientists know that the observations are not a fluke. Something chaotic is very likely going on.

If any life forms did exist in these star systems, and they could look up at the sky, they would have quite a view. Marco Matranga, first author of the paper, from the Harvard-Smithsonian Center for Astrophysics and now a visiting astronomer at the Palermo Astronomical Observatory in Sicily, said, "The skies there would have two huge suns, like the ones above the planet Tatooine in 'Star Wars.'"

Other authors include V.L. Kashyap of the Harvard-Smithsonian Center for Astrophysics; and Massimo Marengo of Iowa State University, Ames.

The Spitzer observations were made before it ran out of its liquid coolant in May 2009, officially beginning its warm mission.

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

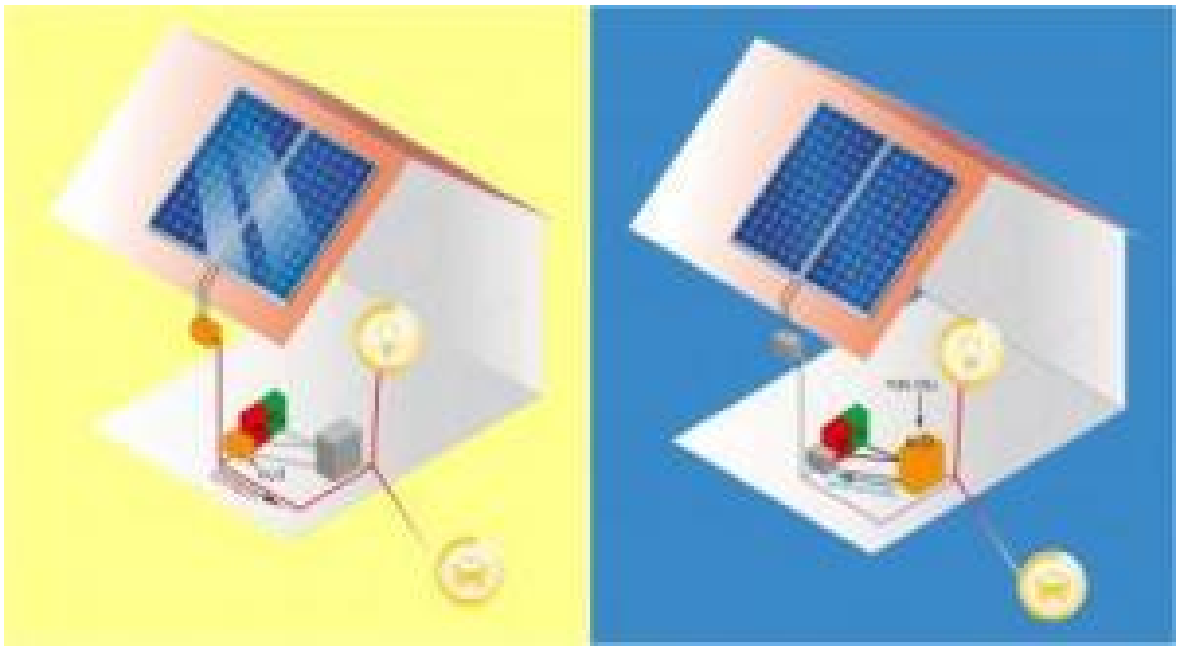
The Infrared Astronomical Satellite, known commonly by its acronym, IRAS, was a joint project between NASA, the Netherlands and the United Kingdom.

Story Source:

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

http://www.sciencedaily.com/releases/2010/08/100823144103.htm

200-Fold Boost in Fuel Cell Efficiency Advances 'Personalized Energy Systems'



A new catalyst could help speed development of inexpensive home-brewed solar energy systems for powering homes and plug-in cars during the day (left) and for producing electricity from a fuel cell at night (right). (Credit: Patrick Gillooly/MIT)

ScienceDaily (Aug. 23, 2010) — The era of personalized energy systems -- in which individual homes and small businesses produce their own energy for heating, cooling and powering cars -- took another step toward reality today as scientists reported discovery of a powerful new catalyst that is a key element in such a system. They described the advance, which could help free homes and businesses from dependence on the electric company and the corner gasoline station, at the 240th National Meeting of the American Chemical Society, being held in Boston.

"Our goal is to make each home its own power station," said study leader Daniel Nocera, Ph.D. "We're working toward development of 'personalized' energy units that can be manufactured, distributed and installed inexpensively. There certainly are major obstacles to be overcome -- existing fuel cells and solar cells must be improved, for instance. Nevertheless, one can envision villages in India and Africa not long from now purchasing an affordable basic system."

Such a system would consist of rooftop solar energy panels to produce electricity for heating, cooking, lighting, and to charge the batteries on the homeowners' electric cars. Surplus electricity would go to an "electrolyzer," a device that breaks down ordinary water into its two components, hydrogen and oxygen. Both would be stored in tanks. In the dark of night, when the solar panels cease production, the system would shift gears, feeding the stored hydrogen and oxygen into a fuel cell that produces electricity (and clean drinking water as a byproduct). Such a system would produce clean electricity 24 hours a day, seven days a week -- even when the sun isn't shining.

Nocera's report focused on the electrolyzer, which needs catalysts -- materials that jumpstart chemical reactions like the ones that break water up into hydrogen and oxygen. He is with the Massachusetts Institute of Technology in Cambridge, Mass. Good catalysts already are available for the part of the electrolyzer that produces hydrogen. Lacking, however, have been inexpensive, long-lasting catalysts for the production of

oxygen. The new catalyst fills that gap and boosts oxygen production by 200-fold. It eliminates the need for expensive platinum catalysts and potentially toxic chemicals used in making them.
The new catalyst has been licensed to Sun Catalytix, which envisions developing safe, super-efficient versions of the electrolyzer, suitable for homes and small businesses, within two years.
The National Science Foundation and the Chesonis Family Foundation provided funding for this study.
Nocera did the research with post-doctoral researcher Mircea Dinca and doctoral candidate Yogesh Surendranath. The U.S. Department of Energy's Advanced Research Projects Agency has recently awarded the team with a grant, which it plans to use to search for related compounds that can further increase the efficiency of its electrolyzer technology. The team hopes that nickel-borate belongs to a family of compounds that can be optimized for super-efficient, long-term energy storage technologies.

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

http://www.sciencedaily.com/releases/2010/08/100823142931.htm

Body Clock Drugs Could Ease Psychiatric Disorders and Jet Lag

ScienceDaily (Aug. 23, 2010) — Researchers have successfully used a drug to reset and restart the natural 24 hour body clock of mice in the lab. The ability to do this in a mammal opens up the possibility of dealing with a range of human difficulties including some psychiatric disorders, jet lag and the health impacts of shift work.

This work is led by Professor Andrew Loudon from the University of Manchester and Dr Mick Hastings of the MRC Laboratory of Molecular Biology in Cambridge, working with a multi-disciplinary team of scientists from Pfizer led by Dr Travis Wager, and is published August 24 in *PNAS.*

Professor Loudon said "It can be really devastating to our brains and bodies when something happens to disrupt the natural rhythm of our body clocks. This can be as a result of disease or as a consequence of jet lag or frequent changing between day and night shifts at work.

"We've discovered that we can control one of the key molecules involved in setting the speed at which the clock ticks and in doing so we can actually kick it into a new rhythm."

Most living creatures and plants have an internal body timing system -- called the circadian clock. This is a complex system of molecules in every cell that drives the rhythmicity of everything from sleep in mammals to flowering in plants. Light and the day and night cycle are very important for resetting the clock and the fine adjustments are made through the action of several enzymes, including one called casein kinase 1, which has been the centre of this project.

Professor Loudon continued "The circadian clock is linked to the 24 hour day-night cycle and the major part of the clock mechanism 'ticks' once per day. If you imagine each 'tick' as represented by the rise and fall of a wave over a 24 hour period, as you go up there is an increase in the amount of proteins in the cell that are part of the clock mechanism, and as you go down, these substances are degraded and reduce again. What casein kinase 1 does is to facilitate the degradation part.

"So you can imagine that the faster casein kinase 1 works, the steeper the downward part of the wave and the faster the clock ticks -- any change in casein kinase 1 activity, faster or slower, would adjust the 'ticking' from 24 hours to some other time period. Consider that if your body suddenly starts working on a 23 hour or 25 hour clock, many of your natural processes, such as sleeping and waking could soon become out of step with day and night."

The team found a drug that slows casein kinase 1 down and used it in mice where the circadian rhythm has ceased i.e. the clock has stopped ticking all together. In live mice and also in cells and tissue samples from mice, they were able to re-establish the ticking of the clock by using the drug to inhibit the activity of casein kinase 1.

Professor Loudon concluded "We've shown that it's possible to use drugs to synchronise the body clock of a mouse and so it may also be possible to use similar drugs to treat a whole range of health problems associated with disruptions of circadian rhythms. This might include some psychiatric diseases and certain circadian sleep disorders. It could also help people cope with jet lag and the impact of shift work."

Professor Janet Allen, BBSRC Director of Research said "The most effective way to develop drugs to treat a health problem is to understand the basic biology that underpins what is going on in our bodies. In this case, by understanding the basic biology of the enzyme controlling biological clocks the research team have been able to identify potential drug-based solutions to a range of issues that affect many people's health and quality of life."

Dr Michel Goedert, Head of the Neurobiology Division at Medical Research Council Laboratory of Molecular Biology said "We're all familiar with jet-lag and that sense of being disoriented in time. What is probably less widely understood is how this effect can impact on those with certain mental illnesses. It is crucial to find out what can go wrong at the molecular and cellular level in the brain if we are to determine what treatments will work for patients. If further studies in humans confirm what this study has shown in mice, this could eventually lead to an entirely new approach to treating mental illnesses such as bipolar disorder."

Dr. Wager, Associate Research Fellow, Pfizer said "It is amazing what can be accomplished when first-rate academic groups and pharmaceutical discovery units team up. Leveraging each other's talents we now have a deeper understanding of the role casein kinase plays within biological systems. Having the ability to entrain or re-entrain an arrhythmic system opens the door to new treatment option for circadian rhythm disorders. Targeting the inhibition of casein kinase with small molecules may lead to the discovery of novel drugs for the treatment of bipolar depression and other circadian rhythm disorders. The burden of these disorders is enormous and new treatment options are needed."

This work was funded by the Biotechnology and Biological Sciences Research Council (BBSRC) and the Medical Research Council (MRC).

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Biotechnology and Biological Sciences Research Council**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Meng et al. **Entrainment of disrupted circadian behavior through inhibition of casein kinase 1 (CK1) enzymes**. *Proceedings of the National Academy of Sciences*, 2010; DOI: 10.1073/pnas.1005101107

http://www.sciencedaily.com/releases/2010/08/100823113428.htm

What the Locals Ate 10,000 Years Ago

The North Creek Shelter, seen here from above, sits at the base of a sheer sandstone cliff. Mark Bodily and Janis Calleja (pictured) worked on the project as master's students. Calleja is now seeking a Ph.D. at Harvard and Bodily works for the U.S. Forest Service. (Credit: Image courtesy of Brigham Young University)

ScienceDaily (Aug. 23, 2010) — If you had a dinner invitation in Utah's Escalante Valley almost 10,000 years ago, you would have come just in time to try a new menu item: mush cooked from the flour of milled sage brush seeds.

After five summers of meticulous excavation, Brigham Young University archaeologists are beginning to publish what they've learned from the "North Creek Shelter." It's the oldest known site occupied by humans in the southern half of Utah and one of only three such archaeological sites state-wide that date so far back in time.

BYU anthropologist Joel Janetski led a group of students that earned a National Science Foundation grant to "get to the bottom" of a site occupied on and off for the past 11,000 years, according to multiple radiocarbon estimates.

"The student excavators worked morning till night in their bare feet," Janetski said. "They knew it was really important and took their shoes off to avoid contaminating the old dirt with the new."

In the upcoming issue of the journal *Kiva*, Janetski and his former students describe the stone tools used to grind sage, salt bush and grass seeds into flour. Because those seeds are so tiny, a single serving would have required quite a bit of seed gathering. But that doesn't mean whoever inhabited North Creek Shelter had no other choice.

Prior to the appearance of grinding stones, the menu contained duck, beaver and turkey. Sheep became more common later on. And deer was a staple at all levels of the dig.

"Ten thousand years ago, there was a change in the technology with grinding stones appearing for the first time," Janetski said. "People started to use these tools to process small seeds into flour."

BYU graduates David Yoder, Mark Bodily and Brad Newbold are also authors on the new study. Though they have moved on in their careers, the group members continue to work with Janetski to investigate the animal bones, projectile points and signs of climate change influencing human diet.

The North Creek Shelter is located at the base of a sheer sandstone cliff on the same property as the Slot Canyon Inn, which now contains an exhibit about the researchers' findings. Janetski notes the generous support received from the property owners, Jeff and Joette Rex.

BYU geology professor Tom Morris and his student Tanner Hicks have also contributed their expertise to the project.

Story Source:

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

http://www.sciencedaily.com/releases/2010/08/100823131743.htm

Low Bone Mineral Density Common in Children and Teenagers With Inflammatory Bowel Disease

ScienceDaily (Aug. 23, 2010) — A thesis from the University of Gothenburg (Sweden) is the first in Scandinavia to study the occurrence of low bone mineral density in children and teenagers with inflammatory bowel disease. Half of the patients in the study showed signs of low bone mineral density. The results emphasise the importance of treating the underlying inflammatory bowel disease more effectively, and of measuring bone mineral density in this group of patients.

Low bone mineral density, or BMD, was evident in around half of the 144 participants with inflammatory bowel disease aged between six and 19 in a major study in western Sweden. Disturbed development of BMD during childhood and adolescence may increase the risk of osteoporosis later in life and thus the likelihood of fractures.

"Possible risk factors for low BMD were more severe disease with increased inflammatory activity in the gut, male gender and low body mass index," says Susanne Schmidt, researcher at the Institute of Clinical Sciences.

Genetic factors also had a major role to play in the children's BMD, aside from their chronic gastrointestinal inflammation which itself can affect BMD.

"We investigated the children's biological parents and measured their BMD," says Schmidt. "We found a clear correlation between the parents' and the children's BMD. Where both parents had a low BMD, a child was six times more likely to have a low BMD too. A similar correlation has previously been described in healthy children and their parents."

However, the researchers saw that after two years the BMD of the oldest patients was showing signs of recovery, which will be investigated more closely in a follow-up study.

According to Schmidt there have, to date, been neither international nor national guidelines for monitoring BMD in children and teenagers with inflammatory bowel disease. She therefore sees a need to introduce checks on BMD, particularly in those patients with risk factors, such as more active disease, low body mass index or parents with a known low BMD.

"The results of the study also underline the importance of optimising the treatment of these patients to minimise the inflammation which is partly behind the low BMD."

Inflammatory bowel disease

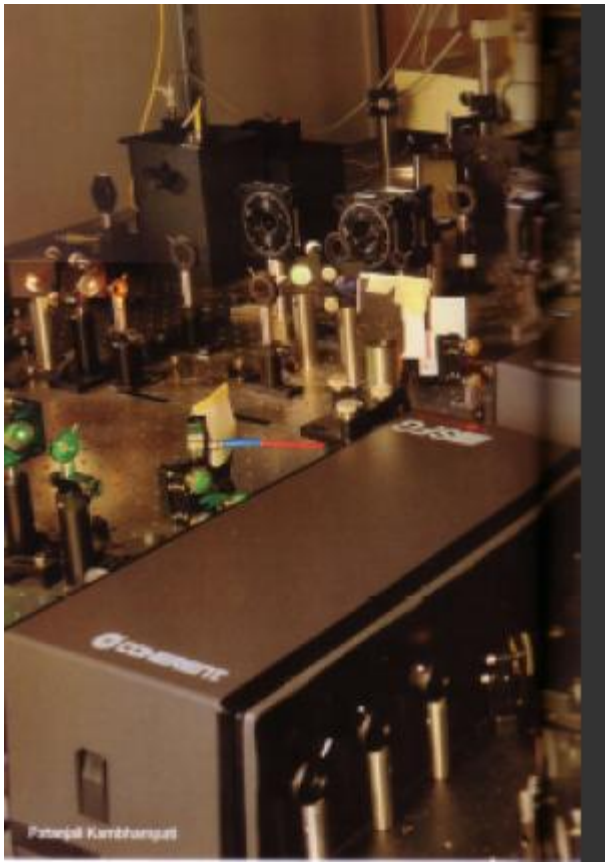
Inflammatory bowel disease, or IBD, is a group of chronic inflammatory conditions -- such as Crohn's disease and ulcerative colitis -- that affect different parts of the gastrointestinal tract. Typical symptoms include loose stools with traces of blood, abdominal pains and poor growth. Almost 1% of the Swedish population has the condition, making it a common complaint, with around a quarter developing it during childhood or the teenage years. IBD has increased significantly over the last few decades among children, both in Sweden and abroad. Around 300 children and teenagers under the age of 18 develop IBD every year in Sweden. It is treated with medicines, surgery and/or nutritional therapy.

Story Source:

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

http://www.sciencedaily.com/releases/2010/08/100823080818.htm

New Atom-Scale Products on Horizon: Breakthrough Discovery Enables Nanoscale Manipulation of Piezoelectric Effect



A laser in Dr. Kambhampati's lab that is used to shine light on quantum dots. (Credit: Image courtesy of McGill University)

ScienceDaily (Aug. 23, 2010) — The generation of an electric field by the compression and expansion of solid materials is known as the piezoelectric effect, and it has a wide range of applications ranging from everyday items such as watches, motion sensors and precise positioning systems. Researchers at McGill University's Department of Chemistry have now discovered how to control this effect in nanoscale semiconductors called "quantum dots," enabling the development of incredibly tiny new products.

Although the word "quantum" is used in everyday language to connote something very large, it actually means the smallest amount by which certain physical quantities can change. A quantum dot has a diameter of only 10 to 50 atoms, or less than 10 nanometres. By comparison, the diameter of the DNA double-helix is 2 nanometres.

The McGill researchers have discovered a way to make individual charges reside on the surface of the dot, which produces a large electric field within the dot. This electric field produces enormous piezoelectric forces causing large and rapid expansion and contraction of the dots within a trillionth of a second. Most importantly, the team is able to control the size of this vibration.

Cadmium Selenide quantum dots can be used in a wide range of technological applications. Solar power is one area that has been explored, but this new discovery has paved way for other nanoscale device applications for these dots. This discovery offers a way of controlling the speed and switching time of nanoelectronic devices, and possibly even developing nanoscale power supplies, whereby a small compression would produce a large voltage.

"The piezoelectric effect has never been manipulated at this scale before, so the range of possible applications is very exciting," explained Pooja Tyagi, a PhD researcher in Professor Patanjali Kambhampati's laboratory. "For example, the vibrations of a material can be analyzed to calculate the pressure of the solvent they are in. With further development and research, maybe we could measure blood pressure non-invasively by injecting the dots, shining a laser on them, and analyzing their vibration to determine the pressure." Tyagi notes that

Cadium Selenide is a toxic metal, and so one of the hurdles to overcome with regard to this particular example would be finding a replacement material.

The research was published in *Nano Letters* and received funding from the Canada Foundation for Innovation, the Natural Sciences and Engineering Research Council of Canada, and the Fonds Québécois de la Recherche sur la Nature et les Technologies.

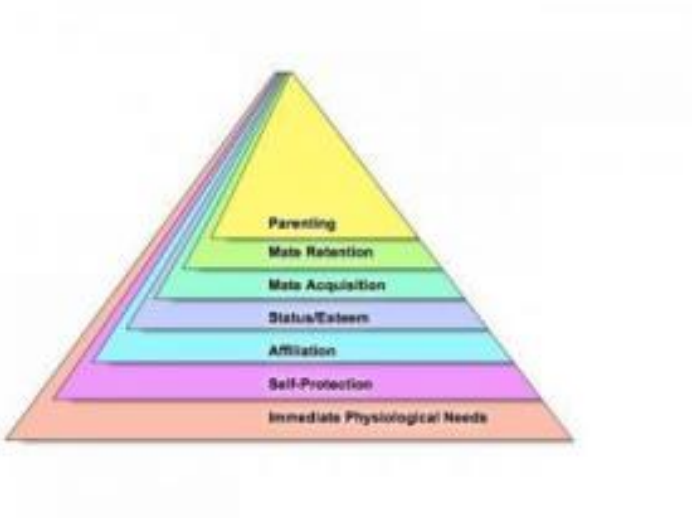
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **McGill University**.

Journal Reference:

1. Pooja Tyagi, Ryan R. Cooney, Samuel L. Sewall, D. M. Sagar, Jonathan I. Saari, Patanjali Kambhampati. **Controlling Piezoelectric Response in Semiconductor Quantum Dots via Impulsive Charge Localization**. *Nano Letters*, 2010; 10 (8): 3062 DOI: 10.1021/nl101605r

http://www.sciencedaily.com/releases/2010/08/100823113432.htm

Maslow Updated: Reworking of the Famous Psychological Pyramid of Needs Puts Parenting at the Top



This is the revised version of Maslow's pyramid of needs. (Credit: Doug Kenrick, Arizona State University)

ScienceDaily (Aug. 19, 2010) — If you have ever felt that your children are your life's work, then you may in fact be recognizing a high-level psychological need. Caring for your children, feeding them, nurturing them, educating them and making sure they get off on the right foot in life -- all of the things that make parenting successful -- may actually be deep rooted psychological urges that we fulfill as part of being human.

This is according to a team of psychologists who have updated a cornerstone of modern psychology -- Abraham Maslow's pyramid of needs. Maslow's pyramid describes human motivations from the most basic to the most advanced. But Maslow's time tested pyramid, first proposed in the 1940s, had begun to look a bit weathered and outdated.

So a team of psychologists, including two from Arizona State University, recast the pyramid. In doing so, they have taken on one of psychology's iconic symbols and have generated some controversy along the way.

The revamp of Maslow's pyramid reflects new findings and theory from fields like neuroscience, developmental psychology and evolutionary psychology, said Douglas Kenrick, an ASU professor of psychology and lead author of the paper, "Renovating the pyramid of needs: Contemporary extensions built upon ancient foundations." The paper was published in the March issue of *Perspectives on Psychological Sciences*.

Despite being one of psychology's most memorable images, Maslow's pyramid hasn't always been supported by empirical research, said Steven Neuberg, an ASU Foundation professor and coauthor of the paper. "Within the psychological sciences, the pyramid was increasingly viewed as quaint and old fashioned, and badly in need of updating," Neuberg added.

"It was based on some great ideas, several of which are worth preserving," Kenrick said. "But it missed out on some very basic facts about human nature, facts which weren't well understood in Maslow's time, but were established by later research and theory at the interface of psychology, biology and anthropology."

Maslow developed the pyramid of needs to represent a hierarchy of human motives, with those at the bottom taking precedence over those higher up. At the base of Maslow's pyramid are physiological needs -- hunger, thirst and sexual desire.

According to Maslow, if you are starving and craving food that will trump all other goals. But if you are satisfied on one level, you move to the next. So, once you are well fed, you worry about safety. Once you are safe, you worry about affection and esteem and so forth. Perhaps most famously, at the top of Maslow's pyramid sat the need for self-actualization -- the desire to fulfill one's own unique creative potential.

The research team -- which included Vladas Griskevicius of the University of Minnesota, Minneapolis, and Mark Schaller of the University of British Columbia, Vancouver -- restructured the famous pyramid after observing how psychological processes radically change in response to evolutionarily fundamental motives, such as self-protection, mating or status concerns.

The bottom four levels of the new pyramid are highly compatible with Maslow's, but big changes are at the top. Perhaps the most controversial modification is that self-actualization no longer appears on the pyramid at all. At the top of the new pyramid are three evolutionarily critical motives that Maslow overlooked -- mate acquisition, mate retention and parenting.

The researchers state in the article that while self-actualization is interesting and important, it isn't an evolutionarily fundamental need. Instead, many of the activities that Maslow labeled as self-actualizing (artistic creativity, for example) reflect more biologically basic drives to gain status, which in turn serves the goal of attracting mates.

"Among human aspirations that are most biologically fundamental are those that ultimately facilitate reproduction of our genes in our children's children," Kenrick explained. "For that reason, parenting is paramount."

The researchers are not saying that artists or poets are consciously thinking about increasing their reproductive success when they feel the inspiration to paint or write.

"Reproductive goals are ultimate causes," Kenrick added, "like the desire of birds to migrate because it helps them survive and reproduce. But at a proximate (or immediate psychological) level, the bird migrates because its brain registers that the length of day is changing. In our minds, we humans create simply because it feels good to us; we're not aware of its ultimate function."

"You could argue that a peacock's display is as beautiful as anything any human artist has ever produced," Kenrick said. "Yet it has a clear biological function -- to attract a mate. We suspect that self actualization is also simply an expression of the more evolutionarily fundamental need to reproduce."

But, Kenrick adds, for humans reproduction is not just about sex and producing children. It's also about raising those children to the age at which they can reproduce as well. Consequently, parenting sits atop the revamped pyramid.

There are other distinctions as well. For Maslow, once a need was met, it disappeared as the individual moved on to the next level. In the reworked pyramid, needs overlap one another and coexist, instead of completely replacing each other. For example, certain environmental cues can make them come back. If you are walking down the street thinking about love, art or the meaning of life, you will revert quickly to the self-protection level if you see an ominous-looking gang of young men headed your way.

The new pyramid already has generated some controversy within the field. The published article was accompanied by four commentaries. While the commentaries agreed with the basic evolutionary premise of the new pyramid, they take issue with some of the specific details, including the removal of self-actualization and the prominence of parenting in the new pyramid.

"The pyramid of needs is a wonderful idea of Maslow's," Kenrick said. "He just got some of it wrong. Now people are talking about it again, which will help us get it right."

Story Source:

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

http://www.sciencedaily.com/releases/2010/08/100819112118.htm

Drugs protect monkeys from Ebola, U.S. study finds

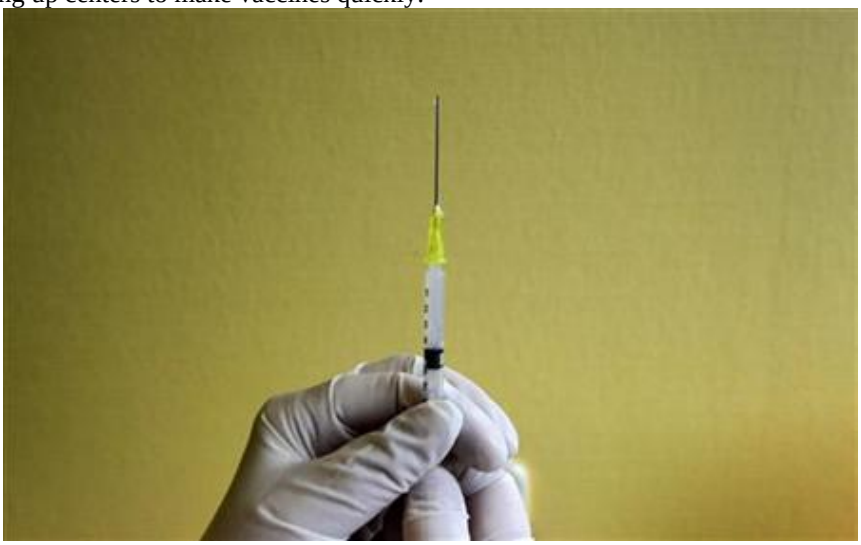
Posted 2010/08/22 at 5:20 pm EDT
WASHINGTON, Aug. 22, 2010 (Reuters) — U.S. government researchers working to find ways to treat the highly deadly Ebola virus said on Sunday a new approach from AVI BioPharma Inc saved monkeys after they were infected.

Two experimental treatments protected more than 60 percent of monkeys infected with Ebola and all the monkeys infected with a related virus called Marburg, the team at the U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID) in Fort Detrick, Maryland reported.
AVI BioPharma already has a contract worth up to $291 million from the U.S. Department of Defense to develop Ebola treatments.
Writing in the journal Nature Medicine, Sina Bavari and colleagues said the drugs tested are antisense phosphorodiamidate morpholino oligomers, or PMOs, called AVI-6002 and AVI-6003.
"Taken together, these studies provide a major advancement in therapeutic development efforts for treatment of filovirus hemorrhagic fever," Bavari's team wrote.
The company has submitted investigational new drug applications for AVI-6002 and AVI-6003 to the U.S. Food and Drug Administration and may now test the drugs in people.
Ebola causes a very serious hemorrhagic fever that has caused dozens of frightening and deadly outbreaks across Africa and threaten endangered gorilla populations as well as people.
It is considered a possible bioterrorism weapon.
There is no treatment and no vaccine against Ebola, which passes via close personal contact and, depending on the strain, kills up to 90 percent of victims.
But several studies in the past few months have shown that experimental "antisense" therapies can stop the virus.
In May a U.S. government team reported that small interfering RNAs or siRNAs could hold the virus at bay for a week until the immune system could take over.
SiRNAs are little stretches of genetic material that can block the action of a specific gene, in this case preventing Ebola from replicating.
PMOs are a little different but also interfere with genes.
An hour after infection with Ebola, 5 of 8 monkeys survived, while the remaining animal was untreated, Bavari's team found.
AVI-6003 worked best, protecting 90 percent or more of monkeys against Ebola, they said, and 100 percent against Marburg.
Canada's Tekmira Pharmaceuticals Corp has a separate contract to develop antisense treatments against Ebola.
(Reporting by Maggie Fox; Editing by Cynthia Osterman)

http://www.newsdaily.com/stories/tre67l216-us-ebola-drug/#

U.S. tries to fix slow response to outbreaks

By Maggie Fox, Health
and Science EditorPosted 2010/08/19 at 2:33 pm EDT
WASHINGTON, Aug. 19, 2010 (Reuters) — The U.S. government proposed major changes on Thursday to the way it works with companies to fight new disease threats such as flu, including reform at the Food and Drug Administration and setting up centers to make vaccines quickly.



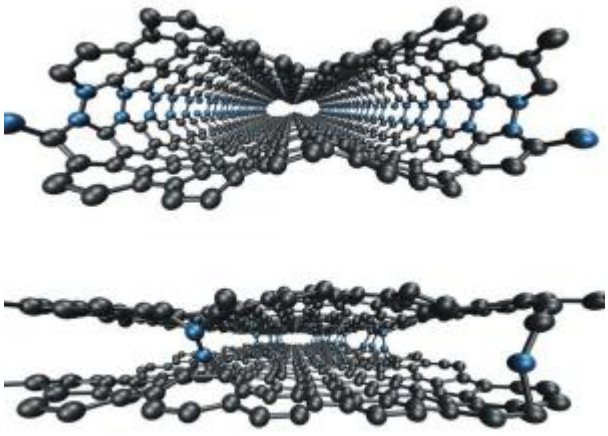
A nurse prepares a H1N1 flu vaccine shot at a hospital in Budapest November 20, 2009. REUTERS/Karoly Arvai

The report from the Health and Human Services Department said the U.S. ability to respond to new outbreaks is far too slow and it lays out a plan for helping researchers and biotechnology companies develop promising new drugs and vaccines.
"The closer we looked ... the more leaks, choke points and dead ends we saw," Health and Human Services Secretary Kathleen Sebelius said at a news briefing.
"At a moment when the greatest danger we face may be a virus we have never seen before ... we don't have the flexibility to adapt," she added. "We saw that we needed better coordination not just within our department but across government."
She said much of the $2 billion needed to make the first changes would come from money already allocated to fight H1N1.
The report suggests providing clearer guidance to industry on regulatory approval of new drugs and vaccines -- something industry has asked for -- and says new teams should be set up at FDA to help this.
"The report does address some key areas that can help make the process more efficient in the event of future public health emergencies," said Karen Lancaster, a spokeswoman for vaccine maker MedImmune, owned by AstraZeneca.
Sebelius said the plan calls for $170 million to kickstart reforms at FDA, including adding "a stronger, expert scientific workforce and infrastructure."
"We are also going to reach out to product developers earlier in the process so they know what to expect," she said.
NEW VACCINE CENTERS
HHS and the Department of Defense should set up Centers for Innovation in Advanced Development and Manufacturing, it said.

"These centers will provide assistance to industry and government by advancing state-of-the-art, disposable, modular manufacturing process technologies," the report said.
"We will not be producing the vaccine," HHS's Robin Robinson said. "We will be there to help manage the products as they go through."
It takes months to make a vaccine against influenza using current processes. While companies are working to modernize their abilities, any big changes are still years away.
"We can use existing tools to cut days, weeks or even a month or two out of our current vaccine production methods," said Dr. Tom Frieden, director of the U.S. Centers for Disease Control and Prevention.
"Accelerated delivery of vaccines by even a few weeks can mean saving tens of thousands of lives," added National Cancer
Institute director Dr. Harold Varmus, who helped write a separate, related report from the Presidential Council of Advisors on Science and Technology.
The report calls for better surveillance to give a much quicker heads-up when new diseases emerge. H1N1 had been circulating for weeks or months before it was detected.
The report says new teams also will look for promising ideas for fighting disease or other threats and make sure they get developed.
"Some of these great ideas are going to come from very small companies that don't really have the capital and wherewithal to get a product from microscope to market," Sebelius said.
(Editing by Bill Trott)

http://www.newsdaily.com/stories/tre67i2bp-us-flu-usa/

Scientists Help Explain Graphene Mystery



ORNL simulations demonstrate how loops (seen above in blue) between graphene layers can be minimized using electron irradiation (bottom). (Credit: Image courtesy of DOE/Oak Ridge National Laboratory)

ScienceDaily (Aug. 23, 2010) — Nanoscale simulations and theoretical research performed at the Department of Energy's Oak Ridge National Laboratory are bringing scientists closer to realizing graphene's potential in electronic applications.

A research team led by ORNL's Bobby Sumpter, Vincent Meunier and Eduardo Cruz-Silva has discovered how loops develop in graphene, an electrically conductive high-strength low-weight material that resembles an atomic-scale honeycomb.

Structural loops that sometimes form during a graphene cleaning process can render the material unsuitable for electronic applications. Overcoming these types of problems is of great interest to the electronics industry.

"Graphene is a rising star in the materials world, given its potential for use in precise electronic components like transistors or other semiconductors," said Bobby Sumpter, a staff scientist at ORNL.

The team used quantum molecular dynamics to simulate an experimental graphene cleaning process, as discussed in a paper published in *Physical Review Letters*. Calculations performed on ORNL supercomputers pointed the researchers to an overlooked intermediate step during processing.

Imaging with a transmission electron microscope, or TEM, subjected the graphene to electron irradiation, which ultimately prevented loop formation. The ORNL simulations showed that by injecting electrons to collect an image, the electrons were simultaneously changing the material's structure.

"Taking a picture with a TEM is not merely taking a picture," Sumpter said. "You might modify the picture at the same time that you're looking at it."

The research builds on findings discussed in a 2009 *Science* paper (Jia et al.), where Meunier and Sumpter helped demonstrate a process that cleans graphene edges by running a current through the material in a process known as Joule heating. Graphene is only as good as the uniformity or cleanliness of its edges, which determine how effectively the material can transmit electrons. Meunier said the ability to efficiently clean graphene edges is crucial to using the material in electronics.

"Imagine you have a fancy sports car, but then you realize it has square wheels. What good is it? That's like having jagged edges on graphene," Meunier said.

Recent experimental studies have shown that the Joule heating process can lead to undesirable loops that connect different graphene layers. The PRL paper provides an atomistic understanding of how electron irradiation from a transmission electron microscope affects the graphene cleaning process by preventing loop formation.

"We can clean the edges, and not only that, we're able to understand why we can clean them," Meunier said. The research team included scientists from Massachusetts Institute of Technology, Universite Catholique de Louvain and Carlos III University of Madrid. Sumpter and Meunier are members of ORNL's Computer Science and Mathematics division with appointments in the Nanomaterials Theory Institute within the Center for Nanophase Materials Sciences. Cruz-Silva is a post-doctoral researcher at ORNL.

Part of this work was supported by the Center for Nanophase Materials Sciences (CNMS) at ORNL. CNMS is one of the five DOE Nanoscale Science Research Centers supported by the DOE Office of Science, premier national user facilities for interdisciplinary research at the nanoscale.

Story Source:

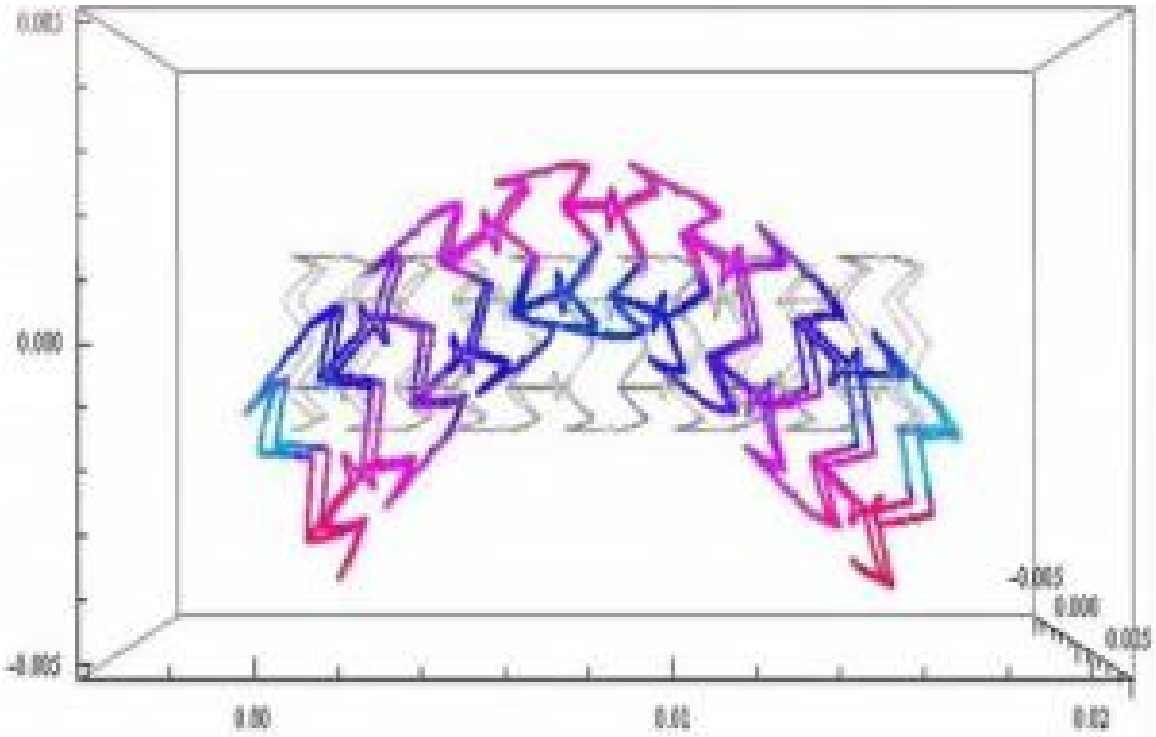
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **DOE/Oak Ridge National Laboratory**.

Journal Reference:

1. E. Cruz-Silva, A. Botello-Méndez, Z. Barnett, X. Jia, M. Dresselhaus, H. Terrones, M. Terrones, B. Sumpter, V. Meunier. **Controlling Edge Morphology in Graphene Layers Using Electron Irradiation: From Sharp Atomic Edges to Coalesced Layers Forming Loops**. *Physical Review Letters*, 2010; 105 (4): 045501 DOI: 10.1103/PhysRevLett.105.045501

http://www.sciencedaily.com/releases/2010/08/100823142935.htm

Math from the Heart: Simulating Stent Design and Coating



Computer models show the varying flexibility of different stent designs. (Credit: S. Canic, M. Kosor and J. Tambaca, University of Houston and University of Zagreb)

ScienceDaily (Aug. 23, 2010) — Suncica "Sunny" Canic was good at math in school, so that's what she pursued as a career. But she always liked medicine, too. When she moved to Houston, Texas, and met some cardiologists at a party, she started talking with them about what they do -- and knew she could help them. "I realized we could provide them with a fluid dynamics and mechanics point of view to help them make decisions about, for example, which stent grafts they use in their procedures," she says.

Stents are tiny mesh tubes made from metal alloys that hold blood vessels open after they've been clogged with disease-causing plaque.

Stents are tiny mesh tubes made from metal alloys that hold blood vessels open after they've been clogged with disease-causing plaque. Even though stents are designed to be compatible with the human body, they sometimes cause unwanted reactions, such as blood clots and scar tissue formation. So scientists have tried to coat stents with cells that make the tiny tubes even more compatible.

But these, too, aren't yet perfect, says Canic. Blood flowing over a coated stent can still clot or tear cells away. This is, as Canic puts it, "not good."

A professor of mathematics at the University of Houston, Canic makes computer models to guide the search for a better stent coating. She also uses computer models to study the strengths and weaknesses of different stent structures. Supported by a joint grant from the National Institute of General Medical Sciences, part of the National Institutes of Health, and the National Science Foundation, her work could help manufacturers optimize stent design and help doctors choose the right stents for their patients, ultimately improving patient outcomes.

Computer scientists usually model stents in three dimensions. Keeping track of about 200,000 points, or nodes, along the stent mesh, the models are massive. Together with a collaborator at the University of Zagreb

in Croatia, Canic wrote a much simpler program that approximates stents as meshes of one-dimensional rods. It let them achieve the same result using just 400 nodes.

Using their simplified model, Canic and her collaborator have examined the designs of several stents on the market to see which structures seem to be best for specific blood vessels or procedures. For instance, they found that stents with an "open design" -- where every other horizontal rod is taken out -- bend easily, which makes them good to put in curvy coronary arteries.

Canic has also used the model to design a stent with mechanical properties specifically tailored to an experimental heart valve replacement procedure. She found that this specialized stent works best for the procedure when it's stiff in the middle and less stiff at the ends.

And she has found that combining bendiness with radial stiffness -- where you can bend the stent into a U shape, but you can't squeeze the tube shut -- produces a stent with less chance of buckling than those that are currently in use.

The most rewarding part of her work, says Canic, is that "we can use mathematics for something useful, connected to real-world problems." She reports that her collaborators are already putting the results of her simulations into practice.

Her greatest challenge, meanwhile, is serving as an ambassador of mathematics to the medical and bioengineering communities.

In the beginning, she says, it was difficult to collaborate with people from different disciplines who speak different scientific languages. "But once they saw that there is a lot of information there that could be helpful, it has been much easier," she says. "Now people want to talk to us from the medical center. They come to us and ask questions, and that's good."

Today, Canic is helping a team at the Texas Heart Institute study an unusual source for stent coating: ear cartilage. The team believes this easy-to-harvest tissue will make stents more biocompatible, though they don't yet know how ear cartilage cells grow or behave in environments like human blood vessels.

So Canic is using her computer programs to simulate how blood interacts with the stent-coating cartilage cells and how the cells stick (or don't) to the stent surface. She plugs in different fluid thicknesses and shear forces of blood flowing over the stent to see what might encourage the cartilage on freshly coated stents to stabilize quickly. The models have helped her collaborators home in on the best conditions to test in follow-up experiments as they search for ways to pre-treat stents before doctors implant them.

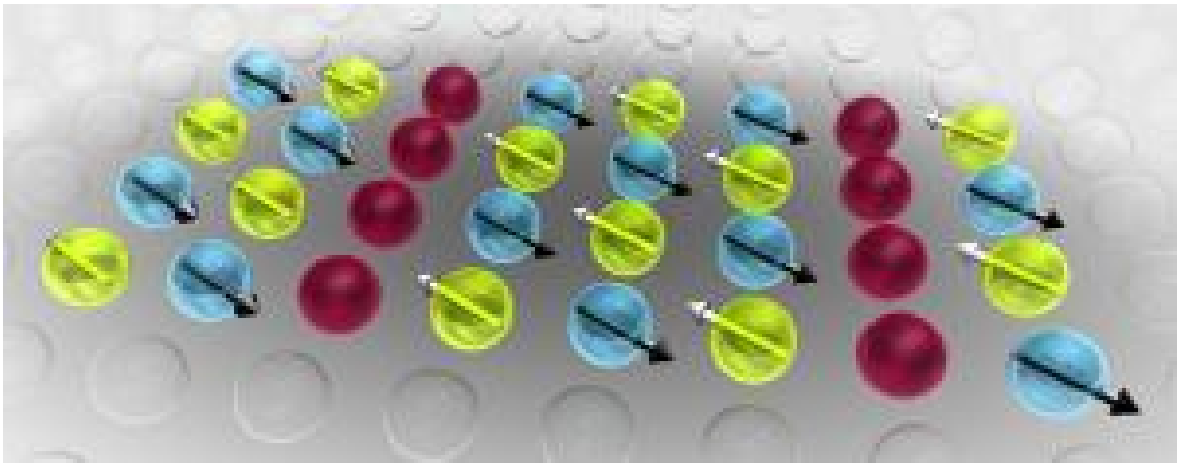
Canic wants to keep collaborating with the medical community as she moves forward with her research. She plans to look at biodegradable stents, as well as simulate the fluid dynamics of regurgitating mitral valves (where some blood flows backwards in the pumping heart) to help doctors more accurately diagnose the condition using ultrasound.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **NIH/National Institute of General Medical Sciences**.

http://www.sciencedaily.com/releases/2010/08/100823121937.htm

Nanoscale Inhomogeneities in Superconductors Explained



Researchers have found that atom clusters with inhomogenous stripes of lower density (shown in red) raise critical temperature needed to reach superconductor state. (Credit: Image courtesy of DOE/Oak Ridge National Laboratory)

ScienceDaily (Aug. 20, 2010) — Superconducting materials, which transmit power resistance-free, are found to perform optimally when high- and low-charge density varies on the nanoscale level, according to research performed at the Department of Energy's Oak Ridge National Laboratory.

In research toward better understanding the dynamics behind high-temperature superconductivity, the ORNL scientists rewrote computational code for the numerical Hubbard model that previously assumed copper-compound superconducting materials known as cuprates to be homogenous -- the same electron density -- from atom to atom.

Lead author Thomas Maier and colleagues Gonzalo Alvarez, Michael Summers and Thomas Schulthess received the Association for Computing Machinery Gordon Bell Prize two years ago for their high-performance computing application. The application has now been used to examine the nanoscale inhomogeneities in superconductors that had long been noticed but left unexplained.
The paper is published in *Physical Review Letters*.

"Cuprates and other chemical compounds used as superconductors require very cold temperatures, nearing absolute zero, to transition from a phase of resistance to no resistance," said Jack Wells, director of the Office of Institutional Planning and a former Computational Materials Sciences group leader.

Liquid nitrogen is used to cool superconductors into phase transition. The colder the conductive material has to get to reach the resistance-free superconductor phase, the less efficient and more costly are superconductor power infrastructures. Such infrastructures include those used on magnetic levitation trains, hospital Magnetic Resonance Imaging, particle accelerators and some city power utilities.

In angle-resolved photoemission experiments and transport studies on a cuprate material that exhibits striped electronic inhomogeneity, scientists for years observed that superconductivity is heavily affected by the nanoscale features and in some respect even optimized.

"The goal following the Gordon Bell Prize was to take that supercomputing application and learn whether these inhomogenous stripes increased or decreased the temperature required to reach transition," Wells said. "By discovering that striping leads to a strong increase in critical temperature, we can now ask the question: is there an optimal inhomogeneity?"

In an ideal world, a material could become superconductive at an easily achieved and maintained low temperature, eliminating much of the accompanying cost of the cooling infrastructure.

"The next step in our progress is a hard problem," Wells said. "But from our lab's point of view, all of the major tools suited for studying this phenomenon -- the computational codes we've written, the neutron scattering experiments that allow us to examine nanoscale properties -- are available to us here."

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **DOE/Oak Ridge National Laboratory**.

http://www.sciencedaily.com/releases/2010/08/100809142046.htm

Powerful New Way to Control Magnetism: Colossal Magnetoelectricity Points the Way to Ultra-Dense Data Storage

ScienceDaily (Aug. 23, 2010) — A team of scientists at Rutgers University has found a material in which an electric field can control the overall magnetic properties of the material. If the magnetoelectric effect discovered by the Rutgers group can be extended to higher temperatures, it could be useful for manipulating small-scale magnetic bits in ultra high-density data storage.

The research appears in the current issue of *Physical Review Letters*.

The researchers found the effect by studying the magnetic properties of a manganite mineral consisting of magnesium, oxygen, europium and yttrium. At low temperatures (7 to 20 degrees above absolute zero) and in high magnetic fields, a slight change in applied electric fields causes a large change in the mineral's magnetic properties. The magnetoelectric effect could lead to advances comparable to the cheap, high capacity hard drives that were made possible with the discovery of giant magnetoresistance.

Unlike devices relying on giant magnetoresistance, which require magnetic fields to manipulate electrical resistance, magnetoelectric decives could be controlled with smaller and simpler electrical read and write heads. Replacing magnetic components with electrical ones could potentially lead to much denser storage than the terabyte discs now available. Related materials that demonstrate magnetoelectricity at much higher temperatures would likely be required before the technology reaches commercial computer components, but discovery of the effect is an encouraging advance.

A Viewpoint by Dimitri Argyriou (Helmholtz Zentrum Berlin für Materialen und Energy) provides an overview of the latest step on the path to colossal magnetoelectricity in this week's edition of *Physics.*

Story Source:

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

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1. Y. J. Choi, C. L. Zhang, N. Lee, and S-W. Cheong. **Cross-Control of Magnetization and Polarization by Electric and Magnetic Fields with Competing Multiferroic and Weak-Ferromagnetic Phases**. *Physical Review Letters*, 2010; 105: 097201 DOI: 10.1103/PhysRevLett.105.097201
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http://www.sciencedaily.com/releases/2010/08/100823121945.htm

The Future of the Web Is a Matter of Semantics

ScienceDaily (Aug. 23, 2010) — The first incarnation of the web was composed of static websites that linked to each other and search engines to help you find sites of interest. Web 2.0 brought a social element to the web, with users sharing, commenting, and interacting through sites such as YouTube, Facebook, and Flickr. The future web, the "semantic web," or Web 3.0, will embed meaning within digital information so that any given page can be understood by computers as well as people.

The inventor of the World Wide Web, Tim Berners-Lee first mentioned the concept of a semantic web, a web with inbuilt meaning, long before the advent of social sites, but it is yet to become reality. This is despite the ongoing efforts of web engineers, academics, search engine companies, and the web industry itself. There is, researchers writing in the International Journal of Web Engineering and Technology, a semantic web bottleneck.

Nikolaos Konstantinou of Athens Information Technology (AIT) and colleagues at the National Technical University of Athens (NTUA), in Greece, state that after almost a decade of research, the fundamental concepts that would underpin a semantic web have matured, yet the average web user cannot yet take advantage of their full potential. They suggest that there are three main issues to be overcome before Web 3.0 emerges and they present a roadmap in their paper to explain how these must be addressed.

In Berners-Lee's original vision for the semantic web, machine-readable information embedded in a digital object, whether a web page, an image, a video or some other file, so-called meta data, would allow software to potentially understand the meaning and context of the digital object. Although some software currently has a limited understanding of simple meta data, it mostly lies in prototypes and lab environments.

However, the potential of the semantic web is to have software agents that can perform tasks automatically based perhaps on a user's behaviour or preference settings, and to locate pertinent information far more efficiently than an individual searching the web manually might do. The software might also be able to infer additional knowledge based on previously existing information process the information it finds into a usefully organised format. Such a process would be useful to scholars, doctors, engineers, scientists, musicians, designers, artists, indeed anyone who works with data.

Konstantinou and colleagues point out that three issues are preventing this from happening: a lack of simplicity, integration with existing technologies and practices, and adoption by the web industry.

They suggest that ways to automatically add meta data to digital objects are now needed to make it possible to publish semantically rich content without manual intervention regardless of whether the "publisher" is a large corporation or an individual content creator. They also say that semantic technologies do not offer a substitute for current practices, rather a complement to them and that web engineers need not abandon experience but should build on it. Finally, the driving forces of the web industry should adopt semantic web technologies since their adoption entails a series of benefits both for the companies themselves as well as to the end users.

"This seems to be the most promising solution for the chicken-and-egg problem of the semantic web," the team says. "Much still needs to be done in order to effectively publish and exploit large-scale semantic information. Following the approach suggested in this paper, we are confident that the semantic web bottleneck will be shortly circumvented and the semantic web vision will be at last realised," the team concludes.

Story Source:

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

1. Konstantinou et al. **Technically approaching the semantic web bottleneck**. *Int. J. Web Engineering and Technology*, 2010; 6: 83-111

http://www.sciencedaily.com/releases/2010/08/100820072147.htm

Sensory hijack: rewiring brains to see with sound

- 17 August 2010 by **Bijal Trivedi**
- Magazine issue 2773.

Hearing is the new seeing (Image: Barbara Schweizer)

A new device that restores a form of sight to the blind is turning our understanding of the senses upside down

CLAIRE CHESKIN used to live in a murky world of grey, her damaged eyes only seeing large objects if they were right next to her. She could detect the outlines of people but not their expressions, and could just about make out the silhouettes of buildings, but no details. Looking into the distance? Forget it.

Nowadays things are looking distinctly brighter for Cheskin. Using a device called vOICe, which translates visual images into "soundscapes", she has trained her brain to "see through her ears". When travelling, the device helps her identify points of interest; at home she uses it to find things she has put down, like coffee cups. "I've sailed across the English Channel and across the North Sea, sometimes using the vOICe to spot landmarks," she says. "The lights on the land were faint but the vOICe could pick them up."

As if the signposting of objects wasn't impressive and useful enough, some long-term users of the device like Cheskin eventually report complete images somewhat akin to normal sight, thanks to a long-term rewiring of their brains. Sometimes these changes are so profound that it alters their perceptions even when they aren't using the device. As such, the vOICe (the "OIC" standing for "Oh, I See") is now proving invaluable as a research tool, providing insights into the brain's mind-boggling capacity for adaptation.

The idea of hijacking another sense to replace lost vision has a long history. One of the first "sensory substitution" devices was developed in 1969 by neuroscientist Paul Bach-y-Rita. He rigged up a television camera to a dentist's chair, on which was a 20-by-20 array of stimulators that translated images into tactile signals by vibrating against the participant's back. Despite the crudeness of the set-up, it allowed blind participants to detect the presence of horizontal, vertical and diagonal lines, while skilled users could even associate the physical sensations with faces and common objects.

By the time he died in 2006, Bach-y-Rita had developed more sophisticated devices which translated the camera's images into electrical pulses delivered by a postage-stamp-sized array of electrodes sitting on the tongue. Users found, after some practice, that these pulses gave them a sense of depth and "openness", a feeling that there was "something out there" (*New Scientist*, 29 July 2005, p 40).

This vague feeling of space, which we experience as part of normal sight, suggests the brain may be handling the information as if it had originated from the eyes. Would it be possible to get even closer to normal vision- perhaps even producing vivid and detailed images- by feeding in information using something other than

tactile stimulation? To find out, physicist and inventor Peter Meijer, based in Eindhoven, the Netherlands, turned to hearing. The ears do not detect as much information as the eyes, but their capacity is nevertheless much greater than the skin's.
Meijer thought up the vOICe in 1982, though it took until 1991 for him to design and build a desktop prototype that would translate video into audio. By 1998 he had developed a portable, if still bulky, version using a webcam, notebook PC and stereo headphones, which allowed users to experiment with the device in daily life. The device is now more discreet, consisting of "spy" sunglasses which conceal a tiny camera connected to a netbook PC, and a pair of headphones. Alternatively, some users download the software to their smartphone, and its built-in camera acts as their eyes.
Every second the camera scans a scene from left to right. Software then converts the images into soundscapes transmitted to the headphones at a rate of roughly one per second (see diagram). Visual information from objects to the wearer's left and right are fed into the left and right ear respectively. Bright objects are louder, and frequency denotes whether an object is high up or low down in the visual field.
At first the soundscapes are reminiscent of the whirring, bleeping and hooting sound effects that would accompany an alien melting the brain of a human in a 1960s science-fiction movie. But by feeling the objects first, to learn to associate the accompanying sounds with their shapes, and by discovering how the soundscape of an object varies as the user moves, the experience becomes particularly "vision-like".
Pat Fletcher of Buffalo, New York, lost her sight at the age of 21 and had just a pinpoint of perception in her left eye, through which she could sometimes see red or green, before she started using the vOICe system in 2000. In the early stages, the pictures in her mind's eye were like "line drawings" and "simple holographic images", but after a decade of practice, she now sees complete images with depth and texture. "It is like looking at an old black-and-white movie from the early 30s or 40s. I can see the tree from top to bottom, and the cracked sidewalk that runs alongside the tree," she says.
It's like looking at a black-and-white movie from the 40s. I can see the tree from top to bottom, and the cracked sidewalk
"What's exciting to me," says Michael Proulx, a cognitive psychologist at Queen Mary, University of London, who has been using the vOICe for his own research, "is that not only can you use this device in a very deliberate fashion where you can think, 'okay, this sound corresponds with this object', but it is also possible, through extensive use, to go beyond that and actually have some sort of direct, qualitative experience that is similar to the vision they used to experience."
The US National Science Foundation is now funding the first controlled study to look at the benefits of the vOICe system while trying to find the optimal training protocol. "Some of the participants in the current trial have learned more in months than [Fletcher] learned in years of using the vOICe," says Meijer. The study, which will involve around 10 participants, may even answer the long-standing question of whether congenitally blind adults can benefit in the same way as Cheskin and Fletcher.
Intended to last about a year, the trial is being run by Luis Goncalves and Enrico Di Bernardo of MetaModal in Pasadena, California, a company that tests sensory substitution devices. The first two participants are a 66-year-old who has been blind from birth but has slight light perception, and a 40-year-old who lost his sight due to diabetes. Twice a week they attend two-hour training sessions, including tasks such as finding a target in a large room and making their way around an obstacle course. "They are empowered by this," says Goncalves, adding that the 66-year-old "can now go to a restaurant and seat himself without asking for assistance and is teaching his wife, who is also blind, how to use the vOICe".
Not everyone is quite so impressed. For example, J. Kevin O'Regan, a psychologist at Descartes University in Paris, France, points out that the system needs time to scan an image and so lacks the immediacy of vision. "I think it's possible with resources and time to make something much better than the vOICe," he says.

Seeing ear to ear?

Nevertheless, vOICe is still of great interest to O'Regan and other researchers, who want to know what these people are experiencing. Are they really seeing? And if so, how?

The traditional view is that the brain takes data from the different sensory organs- in the case of sight, the retina- and, for each sense, processes it in separate regions to create a picture of the outside world. But that cannot explain how someone can have a visual experience from purely auditory information.
As such, O'Regan says our definition of what it means to see needs to change. Our senses, he argues, are defined by the way the incoming information changes as we interact with the environment. If the information obeys the laws of perspective as you move forward and backward, we will experience it as "seeing"- no matter how the information is being delivered. If you have a device that preserves these laws, then you should be able to see through your ears or your skin, he says.
If O'Regan is on the right track, we will have to reconsider long-held ideas of how the brain is organised to deal with incoming information. Traditionally, the brain is considered to be highly modular, with the occipital, temporal and parietal cortices handling inputs from the eyes, ears and from the skin and deep tissues, respectively. According to O'Regan, however, these regions may actually deal with certain types of information- shape or texture, for example- irrespective of which sense it comes from.
There is some evidence to support this view. In 2002, neuroscientist Amir Amedi, now at the Hebrew University of Jerusalem, Israel, published research showing that a specific part of the occipital cortex was activated by touch as well as visual information. He named it the lateral occipital tactile-visual (LOtv) region. Amedi and colleagues hypothesised that the area lit up because the occipital cortex is oriented around particular tasks- in this case, 3D-object recognition- rather than a single sense (*Cerebral Cortex*, vol 12, p 1202).
How does this tally with the vOICe experience? Amedi recently collaborated with Alvaro Pascual-Leone, director of the Berenson-Allen Center for Noninvasive Brain Stimulation in Boston, Massachusetts, to find out whether the vOICe system activates the LOtv when users perceive objects through soundscapes. They asked 12 people, including Fletcher, to examine certain objects such as a seashell, a bottle and a rubber spider using touch and the vOICe system. They were then asked to recognise the same objects using only the soundscapes delivered by vOICe. For comparison, they were also asked to identify objects based on a characteristic sound, such as the jingling of a set of keys.
During the trials, fMRI brain scans showed that the LOtv region was active when expert users like Fletcher were decoding the vOICe soundscapes, but significantly less active when they just heard characteristic sounds. For those using the vOICe for the first time, the LOtv region remained inactive, again suggesting that this area is important for the recognition of 3D objects regardless of which sense produces the information (*Nature Neuroscience*, vol 10, p 687).
Further evidence that this region is vital for decoding soundscapes came two years later, in 2009, from a study using repetitive transcranial magnetic stimulation (rTMS) - short bursts of a magnetic field that temporarily shut down the LOtv of subjects, including Fletcher. "It felt like someone tapping on the back of my head," she says. As the rTMS progressed, her vision with the vOICe deteriorated, and the "world started getting darker, like someone slowly turning down the lights".
As a magnetic field disrupted her visual cortex, the subject's vision with the vOICe device deteriorated. Her world got darker, like someone was slowly turning out the lights
When Fletcher attempted to use the vOICe after undergoing rTMS, the various test no longer made sense. "It was total confusion in my brain... I couldn't see anything." The result was terrifying: "I wanted to cry because I thought they broke my sight - it was like a hood over my head." The rTMS had a similar impact on other vOICe users (*Neuroreport*, vol 20, p 132).
"It turns upside down the way we think about the brain," says Pascual-Leone. Most of us think of our eyes as being like cameras that capture whatever is in front of them and transmit it directly to the brain, he says. But perhaps the brain is just looking for certain kinds of information and will sift through the inputs to find the best match, regardless of which sense it comes from.

Reconfiguring the brain

The question remains of how the vOICe users' brains reconfigured the LOtv region to deal with the new source of information. Amedi's preliminary fMRI scans show that in the early stages of training with vOICe,

the auditory cortex works hard to decode the soundscape, but after about 10 to 15 hours of training the information finds its way to the primary visual cortex, and then to the LOtv region, which becomes active. Around this time the individuals also become more adept at recognising objects with vOICe. "The brain is doing a quick transition and using connections that are already there," says Amedi. With further practice, the brain probably builds new connections too, he adds.

Eventually, such neural changes may mean that everyday sounds spontaneously trigger visual sensations, as Cheskin has experienced for herself. "The shape depends on the noise," she says. "There was kind of a spiky shape this morning when my pet cockatiel was shrieking, and [the warning beeps of] a reversing lorry produce little rectangles." Only loud noises trigger the sensations and, intriguingly, she perceives the shape before the sound that sparked it.

This phenomenon can be considered a type of synaesthesia, in which one sensation automatically triggers another, unrelated feeling. Some individuals, for example, associate numbers or letters with a particular colour: "R" may be seen as red while "P" is yellow. For others, certain sounds trigger the perception of shapes and colours, much as Cheskin has experienced.

Most synaesthetes first report such experiences in early childhood, and it is very rare for an adult to spontaneously develop synaesthesia, says Jamie Ward, a psychologist at the University of Sussex in Brighton, UK. He recently published a chronological log of Cheskin's and Fletcher's experiences, including the synaesthetic ones (*Consciousness and Cognition*, vol 19, p 492).

This capacity to rewire our sensory processing may even boost the learning abilities of sighted users, suggests Pascual-Leone. It might be possible to extract supplementary information by feeding a lot of different sensory inputs to the same brain areas. Art connoisseurs could learn to associate the style of a master's hand with a characteristic sound, and this may help them distinguish genuine work from a fake. Alternatively, it could compensate for low light levels by delivering visual information through our ears. "That's science fiction. But it's interesting science fiction," says Pascual-Leone.

For neuroscientists like Pascual-Leone and Amedi, the research is proof that the ability to learn as we grow old does not disappear. Pascual-Leone says the notion of a critical period during which the brain must be exposed to particular knowledge or never learn it appears "not universally true". "It gives us a reason for hope," he says, "and implies that we should be able to help people adjust to sensory losses with this type of substitution. The capacity to recover function could be much greater than realised."

Bijal Trivedi is a writer based in Washington DC

http://www.newscientist.com/article/mg20727731.500-sensory-hijack-rewiring-brains-to-see-with-sound.html?DCMP=OTC-rss&nsref=online-news

Gulf spill: Is the oil lurking underwater?

- 18:29 20 August 2010 by **Sujata Gupta**

The root of the problem, 23 June (Image: KeystoneUSA-ZUMA/Rex Features)

Between 20 April and 15 July, BP's busted Macondo well released some 4.9 million barrels of oil into the Gulf of Mexico. Within weeks of the leak being plugged, researchers in the area reported on the oil's rapid disappearance. Others are now challenging those early claims.

So is the oil gone or not?

At the surface, the oil does appear to be almost gone. But the big question is whether oil droplets are still around below the surface, and if so how long they will linger. Researchers are divided on this.

For months, the government and BP burned and skimmed oil off the surface. What's more, hot temperatures boosted evaporation and microbial communities that consume surface oil. Estimating what's going on further down the water column and in sediments along the sea floor – is much more challenging.

Of particular interest is the fate of enormous plumes of oil droplets that were seen near the broken wellhead when it was still gushing oil. Richard Camilli and colleagues at the Woods Hole Oceanographic Institute in Massachusetts show in a study out this week that at one point the plume was 2 kilometres wide and 200 metres high. But their measurements were made from 19 to 22 June, before the leak was plugged early this month (*Science*, DOI: 10.1126/science.1195223).

In another study published this week, Robert Hallberg of the National Oceanographic and Atmospheric Administration (NOAA) Geophysical Fluid Dynamics Laboratory in Princeton, New Jersey, used models to estimate how long it would take the Gulf's prevailing currents and oil-eating microbes to disperse and degrade the oil. He found that oil near the surface can abate within weeks, whereas oil trapped in the colder waters below about 1100 metres can take up to two months to disappear (*Geophysical Research Letters*, DOI: 10.1029/2010gl044689, in press).

Contrary to other reports, Camilli also found evidence that oil-munching bacteria were only slowly working through the suspended oil. Together, his and Hallberg's studies suggest that oil will probably remain deep in the water column for at least another month.

But Terry Hazen, a microbial ecologist at Lawrence Berkeley National Laboratory in California, says that he has studied the same plume as the Woods Hole group. His results, which have yet to be published, show that microbes are rapidly eating up the plumes – so much so, he says, that the oil should already have vanished. Hazen is adamant: "The plume is no longer there. It's gone."

Why are the results so different?

For starters, different groups are measuring different things, all of them toxic. Oil is an assortment of hydrocarbons, and microbes consume each component differently. The Woods Hole group is looking at the degradation of monochromatic hydrocarbons known as BTEX, which stands for benzene, toluene, ethylbenzene and xylenes. Hazen, on the other hand, is studying long-chain hydrocarbons such as alkanes. But the discrepancy still puzzles Steven Lohrenz, an oceanographer at the University of Southern Mississippi, Stennis Space Center campus. He is surprised by the Woods Hole group's findings. "I wouldn't expect [the BTEX] to persist for a very long time in seawater," he says.

The difference in the rates at which the researchers believe microbes are breaking down the oil is another point of difference. Of the three, Hazen is the only one to have measured what microbes in the Gulf are actually doing. What's more, other microbial biologists, including Gary King of Louisiana State University in Baton Rouge and Jay Grimes of the University of Southern Mississippi in Ocean Springs agree with his numbers.

Didn't a federal report also find most of the oil has gone?

Yes. The federal government's National Incident Command (NIC) looked at all of the oil that had been released since 20 April. It factored out the oil that had been captured directly at the wellhead, oil that had been burned or skimmed, oil that had evaporated, oil that had been dispersed (both naturally and by chemical dispersants) and oil that microbes had broken down. Combined, that added up to 74 per cent of all the oil that escaped the well. In other words, they say, only 26 per cent of what NIC calls "residual" oil remains in a form that we should be worried about.

But earlier this week researchers at the University of Georgia and the Georgia Sea Grant challenged that interpretation. Almost 80 per cent of the oil has not been recovered, they say. They took particular issue with the NIC's dismissal of dispersed oil hidden below the surface. "One major misconception is that oil that has dissolved into water is gone and, therefore, harmless," says Charles Hopkinson at the University of Georgia in Athens, director of Georgia Sea Grant.

At stake here is the toxicity of dissolved oil in water. According to Hallberg, the Environmental Protection Agency claims that a billion droplets of water contaminated with a droplet of oil is safe to drink. So if, as the NIC suggests, the oil is reaching that point of dilution in the Gulf, we're in the clear. Not so fast, others retort. Even if we can handle some oil in our water, deep-sea animals may not be able to. Unfortunately, it's too early to know how these organisms are faring.

Are researchers still looking for deep oil?

Yes. Just because some researchers can't find plumes doesn't mean that we should stop looking, says David Valentine, a microbiologist at the University of California, Santa Barbara. "It's easy to miss a plume," he says. "There's no way you can go out there and know where this thing is going to be."

Several teams have plans to travel to the Gulf and look for oil trapped in deeper waters. A group headed by Joseph Montoya, a biologist at the Georgia Institute of Technology in Atlanta, is scheduled to begin an extended deep-sea cruise within a week.

Other groups are looking for regions of abnormally low oxygen, which would indicated the oil has been broken down: whenever microbes consume oil, they also deplete the oxygen around them. NOAA observations are already showing extensive regions of depleted oxygen, says Lohrenz.

If these teams find that underwater oil is gone, do we still have to worry about it?

Yes. It's likely that the oil spill has changed the fabric of the ecosystem: generations of fish may already have been wiped out, erosion in marshes may accelerate and the microbial population of the Gulf is already changing. For instance, should large swaths of deeper waters become low in oxygen, microbes capable of living in such hypoxic conditions thrive while others die.

http://www.newscientist.com/article/dn19345-gulf-spill-is-the-oil-lurking-underwater.html

Solar system slips back in time

- 18:00 22 August 2010 by **Jamie Condliffe**

As gases cooled to form our solar system, they gave us the means to measure its age (Image: NASA)

Without celebrating a birthday, the solar system just got hundreds of thousands of years older.

To deduce when its first solid grains formed, researchers analyse structures up to a centimetre across found in meteorites. Such "inclusions" were created when gases cooled to form the sun and planets and are among the oldest solids in the solar system.

Now Audrey Bouvier at Arizona State University in Tempe, and colleagues, have analysed inclusions in a meteorite that fell to Earth in north-west Africa in 2004.

Based on the extent to which uranium-238 and uranium-235 isotopes had decayed into their daughter isotopes lead-207 and lead-206, they say the solar system is 4.5682 billion years old. That's between 0.3 and 1.9 million years older than previous estimates, which relied on the Efremovka and Allende meteorites found in Kazakhstan in 1962 and Mexico in 1969, respectively.

Life-friendly planets

It may seem like a trivial distinction for something billions of years old, but it could make a difference when pinning down the conditions that led to the solar system's formation, says Bouvier – and those needed for other life-friendly planetary systems to form.

"Studies like these help tell us what triggered the formation of the solar system, and how that process occurred," agrees Ray Burgess, a geochemist at the University of Manchester, UK. "They can tell us how our planet formed, and why it has the structure it does."

The Allende meteorite is thought to have undergone great heating and deformation before landing on earth. Burgess says that the African meteorite almost certainly experienced fewer disturbances to its isotopic structure, making for more reliable data.

Journal reference: *Nature Geoscience*, DOI: 10.1038/ngeo941

http://www.newscientist.com/article/dn19344-solar-system-slips-back-in-time.html

Jupiter attacked for third time in 13 months

- 00:13 24 August 2010 by **David Shiga**

For the third time in just over a year, amateur astronomers have detected a comet or asteroid strike on Jupiter. The observations, made possible by the widespread use of astronomical video recordings, show that impacts on the giant planet occur more frequently than previously thought.

On Friday, a small comet or asteroid slammed into Jupiter's atmosphere, producing a brief fireball that was independently recorded by two Japanese amateur astronomers taking video through their telescopes (see the images and videos).

The observation comes hot on the heels of two similar observations by amateur astronomers in the last 13 months – one in June 2010 and the other in July 2009, though in the latter case only a dark bruise left by the impact was observed.

Prior to the three recent observations, only one definite case of a comet or asteroid hitting Jupiter was known – the collision of fragments of comet Shoemaker-Levy 9 in 1994, an event that was predicted in advance and widely observed with professional telescopes. In 1690, however, the Italian astronomer Giovanni Domenico Cassini, who discovered four of Saturn's moons, made drawings of an event that looked suspiciously like an impact.

Best of show

At the time of the 1994 comet strike, astronomers thought that impacts on Jupiter might occur only once in several centuries. But the recent amateur observations suggest that estimate is wrong.

The sudden abundance of such observations is probably thanks to a technique for making very sharp still images by combining the clearest frames from a video recording, says Glenn Orton of NASA's Jet Propulsion Laboratory in Pasadena, California.

Since distortion from the atmosphere changes the quality of astronomical observing, called "seeing", on short timescales, this process allows observers to pull out the best snapshots and ignore blurry frames.

"The results are quite impressive," Orton says.

Orton and a group of astronomers led by Australian amateur Anthony Wesley have suggested setting up a worldwide network of small automated telescopes to continuously monitor Jupiter for impacts.

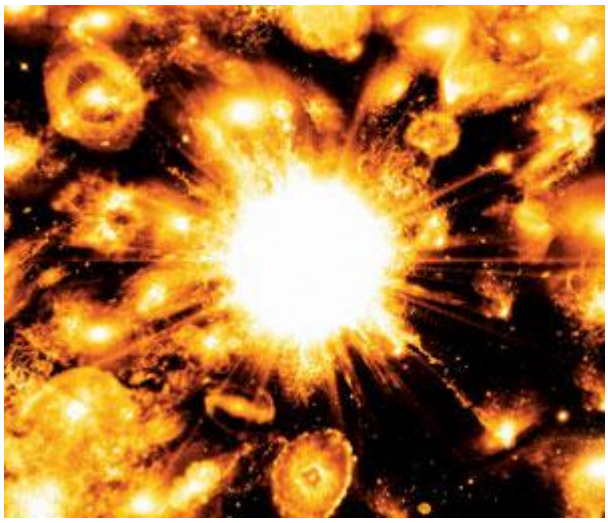
They submitted a proposal on the idea to a committee of the US National Research Council that will set priorities for planetary science for the coming decade in a report to be released in 2011

http://www.newscientist.com/article/dn19354-jupiter-attacked-for-third-time-in-13-months.html

Closing in on the inflaton, mother of the universe

- Updated 16:09 20 August 2010 by **Kate McAlpine**

Magazine issue 2774.



Spot the superparticle (Image: Mehau Kulyk/Science Photo Library)

The inflaton particle is credited with generating the universe and fuelling its inflation. It has yet to be discovered, but it is fast running out of hiding places, thanks to the theoretical framework known as supersymmetry (SUSY).

Enormous and mainly extinct, supersymmetric particles are the dinosaurs of particle physics. Each of these "sparticles" is the partner of a known particle, and they have already solved several cosmological problems, including smoothing the way for a long-sought grand unified theory of physics.

Now two theories suggest that some sparticles might also be components of the elusive inflaton, which is thought to have driven space-time apart at the dawn of the universe.

If either theory turns out to be correct, it would constitute a first glimpse of the cosmic process of inflation. What's more, one of the new theories will soon be put to the test by collisions occurring at the Large Hadron Collider (LHC) at CERN near Geneva, Switzerland.

Most of the inflation period is shrouded in mystery. All we are confident about is that in a fraction of a nanosecond after the big bang, the universe expanded from a size smaller than a proton to somewhere "between a football and a football field", says Stefan Antusch of the Max Planck Institute for Physics in Munich, Germany.

The energy which drove this faster-than-light expansion is believed to have been stored in a field, similar to a magnetic or gravitational field. Every field has an associated particle, according to the standard model of physics - the theory that successfully encompasses all known particles as well as three of the four forces that act on them. In the case of the field thought to have driven inflation, physicists have aptly dubbed this particle the inflaton.

Although little is known about it, if it did exist, the inflaton must have generated all the matter in the universe from the energy stored in its field, so Antusch calls it the "mother of the universe". It would also have to be consistent with the standard model. As a result, some physicists trying to piece together the identity of the inflaton have turned to SUSY (see "Desperately seeking SUSY"), which is an extension of the standard model.

The inflaton must have generated all the matter in the universe from the energy stored in its field

It had previously been suggested that inflation was driven by the Higgs particle - the particle thought to give all others mass- plus a supersymmetric accomplice (*New Scientist*, 19 January 2008, p 11).
Now this notion has strong competition from two more SUSY-based models of the inflaton, both presented at the International Workshop on the Interconnection between Particle Physics and Cosmology in July.
One of these, devised by Antusch's group, assumes the grand unification that SUSY enables: in this version of the early universe, ultra-high energies mean the electromagnetic force is unified with the strong and weak nuclear forces, while every particle and sparticle becomes indistinguishable from all other particles. This "unified" particle is a good potential candidate for the inflaton.
Until recently, however, this idea was still missing a crucial ingredient. To push space-time apart, the inflaton's field must maintain a potential energy in apparently empty space, known as "vacuum" energy. But physicists were long convinced that a unified particle would be too quick to give up the energy of its field, resulting in no inflation.
Now Antusch and colleagues have found a way to extend the time in which the field has a high vacuum energy, by prolonging the period in which the unified particle is nearly massless (arxiv.org/abs/1003.3233). Their method, which is due to be published in the *Journal of High Energy Physics*, relies on a mathematical symmetry often found in string theories. This makes it elegant and logical, and therefore attractive. But Rabindra Mohapatra of the University of Maryland in College Park has doubts. "Symmetries are hard to test," he warns.
The cosmic microwave background (CMB) - relic radiation from the big bang- might offer some clues, though. Observations by the Planck satellite, which measures the CMB, may reveal signs of gravitational waves produced during inflation. In this case, such signs would rule out Antusch's theory because its predicted waves are too small for Planck to detect, but future gravitational wave detectors might be able to spot them.
For the rival SUSY-based model, developed by Rouzbeh Allahverdi at the University of New Mexico in Albuquerque, and his colleagues, testability isn't restricted to deep-space phenomena- it can be probed through particle collisions already occurring at the LHC. That is because, unlike in Antusch's model, inflation takes place far below the energy scales needed for grand unification. This sets limits on the inflaton's mass between 0.1 and 1 trillion electronvolts, well within the LHC's 14 trillion electronvolt capacity (*Physical Review D*, DOI: 10.1103/PhysRevD.82.035012).
It also means that the particles are not unified as in Antusch's model, but are separate entities that can be thought of as energetic points in different fields. So every electron can be thought of as an excitation in the electron field and every selectron - the electron's supersymmetric partner - as an excitation of the selectron field.
Allahverdi's team hypothesised that the inflaton might have been produced by an excitation in a combination of known sparticle and particle fields, so they set about finding a combination that could maintain a sufficiently high energy for long enough to drive the universe apart.
They found two options, both of which involved sparticle fields: one made from the superpartners of electron-like particles, and another made from the superpartners of the quarks that make up a neutron.
In either scenario, the component fields are strongly linked during inflation, providing the energy needed to drive the expansion. Eventually the fields become disconnected, inflation ends and the inflaton radiates energy in the form of particles, generating the contents of the universe. The latest version of their model is due to be published in *Physical Review D.*
Keith Olive at the University of Minnesota in Minneapolis can't quite stomach the degree to which the theory rests on very precise settings for parameters that are themselves still largely unknown. "While it would be nice to be able to associate inflation with 'low energy' physics, the models come with too high of a price," he says.
But Mohapatra points out the theory's strength: "They have been able to connect very abstract ideas of the early universe to experimental tests." The LHC won't find the inflaton per se, but it may reveal the masses of the sparticles thought to compose it, which would allow Allahverdi's theory to be tested.

They have been able to connect very abstract ideas of the early universe to experimental tests
Mohapatra characterises the two new theories as opposing camps, each with its own merits: Allahverdi's builds the inflaton up from particles that still exist today, while Antusch's derives it "top-down" from conditions thought to have existed in the early universe. Results favouring either will not only help unravel the process of inflation, but also shed light on the nature of those strange particle dinosaurs.
In the version of this article printed in New Scientist *magazine, the first three paragraphs read:*
"ENORMOUS and mainly extinct, yet capable of transforming into lighter beings that survive today, supersymmetric particles are the dinosaurs of particle physics.
"Via the theoretical framework known as supersymmetry (SUSY), these "sparticles" - each of which is the partner of a known particle - already solve several cosmological problems, including smoothing the way for a long-sought grand unified theory of physics.
"Now two theories suggest that some sparticles might also be components of the elusive inflaton, the particle credited with driving space-time apart at the dawn of the universe."
When this article was first posted, the reference to Physical Review D*, DOI: 10.1103/PhysRevD.82.035012 was incorrectly cited as arxiv.org/abs/1007.0708*

Desperately seeking SUSY

BORN in the wreckage of a proton collision, the gluino is propelled into the detector- the Compact Muon Solenoid (CMS)- only to get stuck.
Trapped in either the iron discs that carry the magnetic field or the silicon and crystal of the inner detectors, the particle hangs around for crucial moments. Then it decays into gluons and quarks, which produce detectable "jets" that appear as cones of energy on the CMS event displays. But the process is out of sync with other collisions- making the gluino's signal stand out.
Many proponents of the theory of supersymmetry (SUSY) hope this scenario will play out within a year at the Large Hadron Collider (LHC), at CERN near Geneva, Switzerland, CMS's home. It would constitute the first hard evidence for SUSY, which gives a hidden "superpartner" to each known particle and promises to solve some big mysteries (see main story).
The gluino is the hypothetical superpartner of the gluon, which holds nuclei together. It is just one of many superparticles that might materialise in the LHC. But its expected clear signal and potentially high abundance mean that it may be glimpsed earlier than the rest. "This is one reason why we chose to study gluinos - we knew that they would be produced at a sufficiently high rate to be seen with early data," says John Paul Chou of Brown University in Providence, Rhode Island.
Already, CMS has begun to provide data allowing physicists to home in on the gluino's mass- a first step towards identifying it or ruling out its existence. Chou says that once the LHC gets up to design capacity, which could happen as early as next year, the gluino could be found in just a month's worth of CMS data.

http://www.newscientist.com/article/mg20727743.200-closing-in-on-the-inflaton-mother-of-the-universe.html

Lasers could make virtual particles real

- 19:55 17 August 2010 by **David Shiga**

Future lasers will make matter from light (Image: nickwinch/stock.xchng)

Next-generation lasers will have the power to create matter by capturing ghostly particles that, according to quantum mechanics, permeate seemingly empty space.

The uncertainty principle of quantum mechanics implies that space can never be truly empty. Instead, random fluctuations give birth to a seething cauldron of particles, such as electrons, and their antimatter counterparts, called positrons.

These so-called "virtual particles" normally annihilate one another too quickly for us to notice them. But physicists predicted in the 1930s that a very strong electric field would transform virtual particles into real ones that we can observe. The field pushes them in opposite directions because they have opposite electric charges, separating them so that they cannot destroy one another.

Lasers are ideally suited to this task because their light boasts strong electric fields. In 1997, physicists at the Stanford Linear Accelerator Center (SLAC) in Menlo Park, California, used laser light to create a few electron-positron pairs. Now, new calculations suggest next-generation lasers will be able to create such pairs by the millions.

Chain reaction

In the SLAC experiment, only one electron-positron pair was created at a time. But with more powerful lasers, a chain reaction becomes probable.

The first pair is accelerated to high speed by the laser, causing them to emit light. This light, combined with that of the laser, spawns still more pairs, say Alexander Fedotov of the National Research Nuclear University in Moscow and colleagues in a study to appear in *Physical Review Letters*.

"A large number of particles will spill out of the vacuum," says John Kirk of the Max Planck Institute for Nuclear Physics in Heidelberg, Germany, who was not involved in the study.

In lasers that can concentrate about 10^{26} watts into a square centimetre, this runaway reaction should efficiently convert the laser's light into millions of electron-positron pairs, the team calculates.

Antimatter factory

That kind of intensity could be reached with a laser to be built by the Extreme Light Infrastructure project in Europe. The first version of the laser could be built by 2015, but it could take a few years after that to complete upgrades necessary to reach 10^{26} per square centimetre, says study co-author Georg Korn of the Max Planck Institute for Quantum Optics in Garching, Germany.

The ability to generate large numbers of positrons could be useful for particle colliders like the proposed International Linear Collider, which will smash electrons and positrons together, says Kirk McDonald of Princeton University in New Jersey.

But Pisin Chen of National Taiwan University in Taipei says the cost of the very powerful laser might make this method more expensive than the alternative. The standard way to create large numbers of positrons today is to fire a beam of high-energy electrons at a piece of metal to produce electron-positron pairs.

http://www.newscientist.com/article/dn19327-lasers-could-make-virtual-particles-real.html

Milky Way magnets solve cosmic ray conundrum

- 16:58 17 August 2010 by **Kate McAlpine**

Could the exploding star that left this shock wave behind have made cosmic rays too? (Credit: ESO/E. Helder and Chandra/NASA)

A portion of the high-energy cosmic rays raining down on Earth could have been swirling around the Milky Way for millions of years. The idea could help solve a conundrum that has puzzled physicists for the past year.

Cosmic rays are protons and nuclei of varying energies that regularly strike Earth. Little is known about them, but it is assumed that those with higher energies should have lower masses, as they are thought more likely to break up en route to Earth.

It was therefore a surprise when the Pierre Auger Observatory in Argentina last year reported that the average mass of cosmic rays was increasing at high energies.

Now a team led by Alexander Kusenko of the University of California, Los Angeles, have an explanation.

Magnetic retention

The crux of their idea is the recent finding that the explosions in other galaxies believed to form cosmic rays, such as gamma ray bursts, can happen in the Milky Way too.

To find out if this could explain the heavy cosmic rays, Kusenko's team calculated the numbers of protons and nuclei that such explosions would produce and whether the Milky Way's magnetic field would be able to retain them.

At low energies, both protons and nuclei were deflected by the magnetic field and therefore retained in the galaxy for millions of years. But at high energies, the protons tended to escape while the heavier, less mobile nuclei hung around.

This could account for the increase in heavy cosmic rays seen at high energies by Auger, say the team. "Gamma ray bursts inject high-energy nuclei that get trapped in the galactic magnetic field and are observed some million years later as cosmic rays," says Kusenko.

Survival of the nucleus?
Michael Kachelreiss of the Norwegian University of Science and Technology in Trondheim remains sceptical that nuclei can survive acceleration to such high energies. He points out that the Auger results have not yet been confirmed by other experiments.

"It is essential to assess whether the particles really are nuclei or if they are protons with unexpected interaction properties," adds Jim Matthews of Louisiana State University in Baton Rouge.

The work will appear in *Physical Review Letters*.

http://www.newscientist.com/article/dn19326-milky-way-magnets-solve-cosmic-ray-conundrum.html

Online games are a gold mine for design ideas

- 23 August 2010 by **Colin Barras**
- Magazine issue 2774.

Take that, bot (Image: UbiSoft Entertainment/Games Press)

GONE are the days when video gaming was a private pursuit. Gaming services such as Microsoft's Xbox Live not only connect players in living rooms the world over, they can also record every move each gamer makes. Academic researchers are learning to use information mined from this mountain of data to build more stimulating games - and commercial games designers are beginning to take notice.

"All of the big games publishers are getting into data mining," says Julian Togelius of the Center for Games Research at the IT University of Copenhagen, Denmark. "They're talking to universities, even hiring researchers to work on some of these huge data sets."

The trend is all the more remarkable because games designers are usually reluctant to collaborate with academics. Togelius says that designers find most aspects of academic games research, such as artificial intelligence (AI), too esoteric to use as part of the development process. Using data mining to study how gamers play existing titles, though, can give developers instant rewards, such as identifying points in a game where players are likely to become frustrated or bored. The insights could help to tailor future releases to make them more satisfying.

There is a problem, however. The data sets are so dauntingly complex that analysing them can defeat even the most skilful and experienced games designer. But here smart software developed by academic researchers can step in to help uncover patterns that are hidden from humans.

The easiest way to treat the data is to look for direct correlations - perhaps a large number of players losing a life at a particular spot. But other patterns are only revealed by delving deeper into the data. To do this, researchers turn to algorithms similar to those used by banks to pick out fraudulent behaviour from a mass of legitimate transactions. "Machine-learning algorithms are great at finding patterns," says Ben Weber at the University of California, Santa Cruz.

At the Conference on Computational Intelligence and Games (CIG 2010) in Copenhagen this week, Togelius, Anders Drachen and Georgios Yannakakis are presenting their research on data mined from 10,000 Xbox Live gamers as they played *Tomb Raider: Underworld*. "It turns out that we can rather accurately predict whether or not a player will finish the game by just looking at a few features of their game play," says Togelius.

For each gamer, Togelius and his team identified several features of play, such as how much time they spent in a particular room in the first level, and the number of rewards they collected. The team then fed the data

through software containing a suite of prediction and classification algorithms to produce their final predictions.

Researchers are also using data mining to improve computer-controlled characters within the game, which helps them react appropriately to the range of different strategies that players can adopt in today's complex games. Programming these characters to react sensibly to different tactics is labour-intensive. "That's motivating the need to begin automating the process," Weber says.

To explore what can be done with artificial agents, Weber has cribbed data from the mother of all computer strategy games, *StarCraft*. Released by Blizzard Entertainment in 1998, *StarCraft* pits three alien races against each other in a bid for dominance. Over the years, its devoted legion of fans have fine-tuned their strategies to levels of sophistication on a par with those of a chess grandmaster, Weber says.

To help newcomers get into the game, community websites host replays of previous games between the top players. The idea is that novices study these games to learn which strategies are winners, but AI researchers are now using this resource to enable their software to do the same.

Weber has used this approach to create a robot player called EISBot. He downloaded thousands of replays, and used machine-learning algorithms to identify patterns in the data that helped predict how games would unfold. That knowledge was then encoded into EISBot. After only a few minutes of game play, EISBot can predict an opponent's strategy with 70 per cent accuracy at least 2 minutes before it is executed - an advantage in a real-time game.

The goal is to create a bot that is a challenging opponent, but not so good it beats you every time

If anything, robots like EISBot play games too well to be incorporated into commercial games. "Gamers will expect more and more realistic behaviour from the characters in games," says Johan Pfannenstill, a lead programmer at video game company Ubisoft Massive based in Malmö, Sweden. "It is very important to try to meet those expectations." Make characters too smart and they "jeopardise the intended experience for the player", he says.

Pfannenstill might be more comfortable with the approach being followed by Philip Hingston at Edith Cowan University in Perth, Australia. He is also using data mining - this time from the first-person shooter game *Unreal Tournament 2004* (UT2004) - to make bots behave more like human players. His studies suggest gamers prefer these opponents.

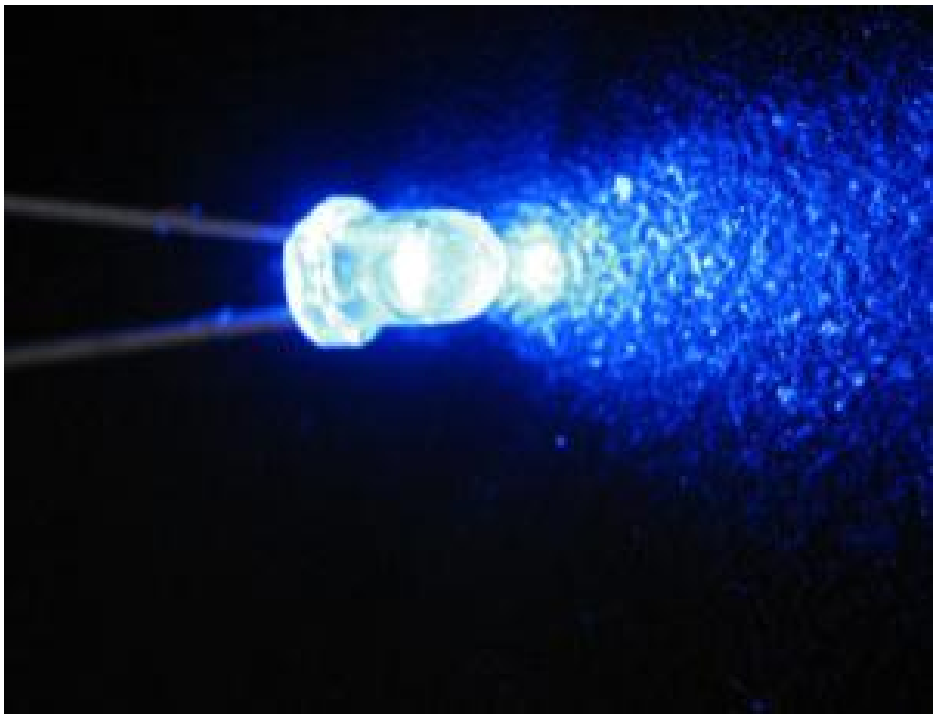
Hingston's goal is to make the bots just intelligent enough to pass as human rather than so intelligent that they take control of the game. So he has begun using UT2004 as the backdrop for a gaming equivalent of the Turing test. For this, he sets up a UT2004 environment in which both humans and bots are playing, and asks the human players to say which they think is which.

As *New Scientist* went to press, the latest round of Hingston's Turing test for bots competition was in full swing at CIG 2010. Hingston thinks he knows what characteristics will define the victor. The bots "need to strike a balance between appearing superhuman and too stupid to be human". Despite Pfannenstill's concerns, most data-mined AI bots excel at the latter but not yet at the former.

http://www.newscientist.com/article/mg20727745.100-online-games-are-a-gold-mine-for-design-ideas.html

Making light work of LED droop

- 11:05 20 August 2010 by **Andy Extance**



Glow with the flow (Image: ko:User:Hoenny/Wikimedia Commons)

The drive to bring eco-friendly LED lighting into our homes is being stopped in its tracks by an embarrassing problem known as droop – the disappointing reduction in efficiency that happens when the light bulbs operate at the high power levels they need to shine at their brightest.

"Efficiency droop is one of the main obstacles to achieving cost-effective and high-efficiency LEDs," says Seong-Ju Park at the Gwangju Institute of Science and Technology (GIST) in South Korea. "Droop becomes a very important issue as LEDs expand into applications like [indoor] lighting where they operate at high currents."

For years, LED production has grown in tandem with the cellphone, providing the backlight for their displays. But manufacturers will have to tackle droop before high-power LEDs can hit the big time.

The cause of LED droop is disputed, making the solution to the problem far from clear – but now, Park and colleagues at GIST have teamed up with Samsung LED to prop up this flagging performance with an unconventional device design.

A standard LED has a surplus of electrons on one side and a dearth of electrons – or an abundance of electron "holes" – on the other. Plug the LED into a circuit, and the electrons and holes move towards each other, combine, and release energy as light.

Droop means that the proportion of the recombinations that produce light peaks at low electrical powers, with the record-holding prototype devices reaching about 250 lumens per watt. Raise the power to levels typically used for indoor lighting, though, and an increasing proportion of the electric current is lost as heat, so the efficiency drops below 100 lumens per watt.

A trap to catch an electron

The electrons and holes are caught in tiny traps called quantum wells, where they are more likely to collide and recombine. In commercial white LEDs, quantum wells are made of gallium nitride (GaN) surrounded by barriers on either side made from indium gallium nitride (InGaN).
But conventional manufacturing techniques simply juxtapose the InGaN and GaN layers, creating an abrupt interface that physically strains the semiconductor material and generates an electrical field, which Park's team suggest might cut the chances of electrons and holes combining and emitting light.
To test the idea, the researchers changed the nature of the interface between the well and its barrier by introducing the indium more gradually. That created a steady gradient between the barriers and the well. By smoothing the interface between these layers, they could reduce the strain and thus weaken the electric field surrounding the quantum wells.
When compared against a conventional design, the team's LED rapidly becomes 20 per cent more efficient as the power goes up, generating more light and less heat. While similarly raised efficiencies have been reported before, the Korean team's approach reaches these levels at much lower currents and then sustains them.
"The paper appears to be an interesting contribution to the wide-ranging debate on droop," comments Rachel Oliver from the Centre for Gallium Nitride at the University of Cambridge, UK, However, she warns that LED droop is a complicated issue and unlikely to have a single, simple solution. "To really solve this important problem will require more wide-ranging and systematic studies."
Journal reference: *Journal of Physics D*, DOI: 10.1088/0022-3727/43/35/354004

http://www.newscientist.com/article/dn19343-making-light-work-of-led-droop.html

Hand-held controls move out of sight

- 14:48 23 August 2010 by **Gareth Morgan**

Buttons on the back next time? A PSP 3000 console at the 2010 International Consumer Electronics Show in Las Vegas last January (Image: David Becker/Getty Images)

Innovation *is our regular column highlighting emerging technologies and predicting where they may lead*

Portable computers, from games machines to smartphones, are now much more hands-on thanks to the proliferation of touchscreen technology. But touchscreens suffer from a debilitating problem: touching them stops you being able to see all the action.

For some time researchers have suggested the answer to this so-called "occlusion problem" is to put controls on the back of the device, but now there are signs that sophisticated rear-mounted controls may be inching towards commercial reality. Last week, gaming website Eurogamer reported that some who have seen the next version of Sony's PSP portable console say it will sport touch controls on its back.

Sony has refused to be drawn on the rumours, but if they prove correct, it would not be the first tech firm to explore the idea. *New Scientist* reported in 2007 on work at Microsoft and Mitsubishi research labs to create LucidTouch, a large, transparent hand-held LCD device with touch-sensitive panels on the rear. Subsequent devices such as the NanoTouch have demonstrated that people can use rear-mounted sensors accurately, even if they can't see their fingers.

Those prototype gadgets featured relatively simple rear-facing controls. But many of us are so familiar with full keyboards that it may be practical to put them on the rear of hand-held devices.

Touch typing

James Scott, a computer interface researcher based at Microsoft Research labs in Cambridge, UK, will present a paper at next month's Mobile Human-Computer Interaction conference in Lisbon, Portugal, showing how LucidTouch's panel sensors have evolved into a mobile device with a qwerty keyboard on the rear.

RearType supports 10-fingered touch typing. There are two rows of four buttons on the front for thumbs; the qwerty keyboard is split in two, as on a split ergonomic keyboard, with each half rotated through 90 degrees. The thumb-controlled front-facing buttons include frequently used keys including shift, delete and enter (see photos, right).

When a key is pressed, a virtual keyboard appears the right way round on the device's screen, highlighting which key has been pressed.

To test the devices, Scott and his colleagues advertised for volunteers to take part in a typing trial. They were looking for so-called finger typists – people with a moderate ability to type without looking at the keyboard. After an hour's tuition the 12 volunteers had an average speed of 15 words per minute – far lower than their speeds on a traditional keyboard, but on a par with the sorts of speed users manage with a touchscreen keyboard. With some adjustments to the keyboard layout to make it easier to reach all the keys, the researchers think that typing speeds will increase.

http://www.newscientist.com/article/dn19347-innovation-handheld-controls-move-out-of-sight.html

Acoustic archaeology: The secret sounds of Stonehenge

- 12:50 23 August 2010 by **Trevor Cox**

Ready to rock (Image: Richard Nowitz/National Geographic/Getty)

Trevor Cox *reveals how the acoustic footprint of the world's most famous prehistoric monument was measured*

Read more: *Echoes of the past: The sites and sounds of prehistory*

Just after sunrise on a misty spring morning last year, my fellow acoustician at the University of Salford, Bruno Fazenda, and Rupert Till of the University of Huddersfield, UK, could be found wandering around Stonehenge popping balloons. This was not some bizarre pagan ritual. It was a serious attempt to capture the "impulse response" of the ancient southern English stone circle, and with it perhaps start to determine how Stonehenge might have sounded to our ancestors.

An impulse response characterises all the paths taken by the sound between its source – in this case a popping balloon – and a microphone positioned a few metres away. It is simply a plot of the sound pressure at the microphone in the seconds after the pop. The first, strongest peak on the plot represents the sound that travelled directly from the source to the microphone. Later, smaller peaks indicate the arrival of reflections off the stones. The recording and plot shows the impulse response Bruno and Rupert measured with a microphone positioned at the centre of Stonehenge and a popping balloon at the edge of the circle.

This impulse response represents an acoustic fingerprint of the stones. Back in the lab, it can be used to create a virtual rendition of any piece of music or speech as it would sound within the stone circle. All that is needed is an "anechoic" recording of the raw music or speech – a recording made in a reflection-free environment such as the open air or, better, a specialist anechoic chamber such as we have at Salford. The anechoic recording and the impulse response can then be combined using a mathematical operation called convolution.

We've done with with a recording of drumming: here is the anechoic original, and here it is convolved with the measured impulse response of Stonehenge. The difference is easily appreciable: there is more reverberation or ringing to the drumming sound thanks to the reflections off the stones. What's more, the tonal balance of the sound is entirely different: it has become much deeper, as if the treble has been turned down.

Replica henge

The popping of a balloon is not the standard or best way to measure an impulse response, but more sophisticated equipment was not allowed at Stonehenge. At a full-size replica of the monument at Maryhill, Washington state, however, Bruno and Rupert were able to use powerful loudspeakers and special test signals to get more accurate results.

Maryhill also has the advantage that it is complete, whereas some of the stones of Stonehenge have fallen or disappeared over the years. That makes a noticeable difference to the drum sounds convolved with Maryhill's impulse response: the more complete stone circle makes the sound echo for longer, with the extended reverberation being most noticeable after the last drum.

Over many decades, a sophisticated understanding of how to interpret impulse responses has been built up. For example, we now know how features within the impulse response, such as the time it takes for reverberations to die away, relate to peoples' perceptions of the nature of the sound. The hope is that by applying that expertise to ancient monuments such as Stonehenge, we can better appreciate their acoustical effects on our ancestors –and perhaps begin to answer the question whether these effects were the product of accident or design.

Trevor Cox is professor of acoustic engineering at the University of Salford, UK, and president of the UK Institute of Acoustics

http://www.newscientist.com/article/dn19276-acoustic-archaeology-the-secret-sounds-of-stonehenge.html

How collapsing bubbles could shoot cancer cells dead

- 20 August 2010 by **Jamie Condliffe**

Magazine issue

The power of collapsing bubbles (Image: Christopher Stevenson / Photonica / Getty)

JETS of fluid propelled by the collapse of microscopic bubbles could deliver drugs directly into cancer cells, if an idea from a team of engineers pays off. They have made the bubbles project a fine jet that is powerful enough to puncture the cell wall and enter the cell.

Applying a pulse of heat or ultrasound to a fluid can produce bubbles that initially expand rapidly, before collapsing suddenly when the pulse ends. Pei Zhong and his team at Duke University in Durham, North Carolina, knew that the collapsing bubbles send a pressure wave through the surrounding fluid, and that oscillations at the surface of the bubble can generate a needle-like jet. The problem is predicting where the jet will go, and how powerful it will be.

"Previously, there has been little control in jetting direction, and it has been hard to control the strength of the jet," Zhong says. Now the team has shown that when pairs of bubbles collapse in close proximity, they interact in a predictable way.

Using successive pulses from two lasers, one with a wavelength of 1064 nanometres and the other radiating at 532 nanometres, the team rapidly heated a sample of fluid containing the dye trypan blue. The first pulse produced a bubble of vapour 50 micrometres across, and the second produced another bubble close to the first. As the bubbles cooled and contracted, their surfaces began to oscillate, creating vortices in the surrounding fluid. The interaction between neighbouring bubbles caused them to collapse, creating a pair of jets shooting out in opposite directions. This should provide the degree of control necessary for a targeted drug delivery system, Zhong says.

The size of the bubble is crucial, as it dictates the size of the jet, Zhong says. "We want to produce a tiny jet that can penetrate a cell without killing it," he adds.

Zhong and his team tested their bubble needle on cells obtained from a rat tumour. High-speed photography showed that the microbubble pair could be made to collapse in such a way that the jet of blue dye created a hole between 0.2 and 2 micrometres across - allowing the jet of liquid to enter without instantly destroying the cell (*Physical Review Letters*, DOI: 10.1103/PhysRevLett.105.078101). This shows the jets are suitable for targeting drugs at cells within the body, Zhong says.

He says that it should be possible to use microbubble pairs generated by ultrasound rather than lasers as a clinical drug-delivery system.

Not everyone is convinced that the system will work in a clinical setting, however. In the presence of biological tissues, the oscillating bubbles may be less stable than in the test solution, making it difficult to deliver drugs with any accuracy, says Constantin Coussios, a biomedical engineer at the University of Oxford.

http://www.newscientist.com/article/mg20727745.300-how-collapsing-bubbles-could-shoot-cancer-cells-dead.html

First gold-iron alloy shows power of magnetic attraction

- 19 August 2010 by **Kate McAlpine**
- Magazine issue 2774. **Subscribe and save**

GOLD readily forms alloys with the precious metals silver and palladium, but it normally blends with cheap iron about as well as oil mixes with water. That has now changed, with the creation of a gold-iron alloy that is held together by magnetism.

The arrangement of atoms in an alloy changes the chemical properties of its constituent metals and makes it potentially useful to catalyse reactions. This prompted Sylvie Rousset and colleagues at the Denis Diderot University, Paris, and the French National Centre for Scientific Research to explore creating one from gold and iron. But creating a gold-iron alloy is problematic because of the differing sizes of the atoms. Locked in a crystal lattice, each gold atom has an effective radius of 0.29 nanometres, while an iron atom has a radius of just 0.256 nanometres.

The researchers overcame this obstacle by using ruthenium as a "bridge" between the two. With an effective atomic radius of 0.273 nanometres, a bed of ruthenium can guide the growth of a gold-iron lattice.

Rousset's team vaporised iron and gold and deposited them on a slab of ruthenium, before heating the slab to 330 °C to allow the atoms to migrate into a single-layered lattice.

The team tested a number of combinations of iron and gold to see which led to the most stable arrangement. Theoretically, stability should be found in a mix containing about 80 per cent iron, as this minimises the mechanical strain caused by the atoms' different sizes. However, to their surprise they found that the most stable lattice contained approximately one iron atom to every two gold atoms (*Physical Review Letters*, DOI: 10.1103/PhysRevLett.105.056101).

In this combination there was evidence of long-range order: a repeating pattern of interconnected hexagons of gold, each with an iron atom at its centre.

Rousset suggests that iron's magnetism is behind this stability. The iron atoms have their strongest magnetic properties when they make up one-third of the alloy, she says.

"What is remarkable is the absolute dominance of the magnetic interaction," says Gayle Thayer of Sandia National Laboratories in Albuquerque, New Mexico. "The long-range order is also spectacular."

The absolute dominance of the magnetic interaction in a gold-iron alloy is remarkable

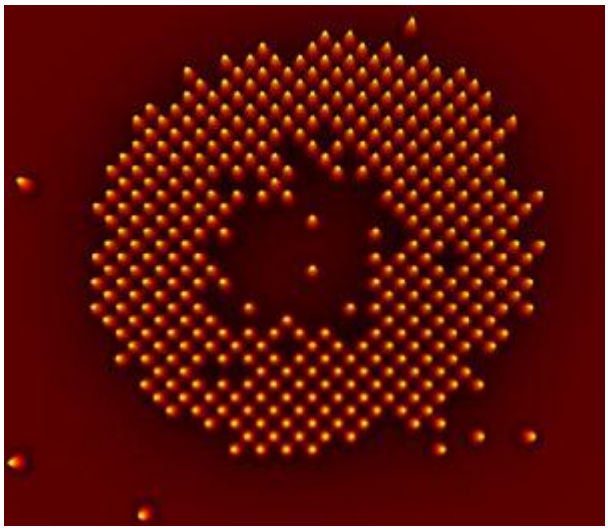
If the magnetism can be switched between two orientations when a magnetic field is applied, and maintain that orientation at the temperatures found inside computers, the alloy could function as a high-density computer memory array, says Rousset.

http://www.newscientist.com/article/mg20727745.400-first-goldiron-alloy-shows-power-of-magnetic-attraction.html

Atom images raise quantum computer hopes

- 18 August 2010 by **Kate McAlpine**

Magazine issue 2774.



Atom distribution of an ultracold quantum gas held in a two-dimensional crystal of light (Image: Stefan Kuhr & Immanuel Bloch, Max Planck Institute for Quantum Optics)

FAST quantum computers made of atoms trapped by beams of light could be a step closer, thanks to the first images of the individual atoms in such a grid.
Quantum computers get their speed from the fact that their components can occupy a range of states rather than just two as in a binary computer. Special algorithms can exploit these quantum states to solve problems that would defeat a conventional computer.
One candidate for such a computer is a so-called optical lattice, in which ultracold atoms are coaxed by strategically placed laser beams into a grid arrangement, rather like eggs in an egg carton. But before we can read and write to these atoms, which will be necessary if the lattice is to act as a quantum computer, their precise positions need to be determined.
Now two teams, one led by Stefan Kuhr of the Max Planck Institute for Quantum Optics in Garching, Germany, the other by Markus Greiner of Harvard University, have taken a first step by imaging the individual rubidium atoms in an optical lattice. This is a challenge not just because the atoms are tiny, but also because photons from nearby atoms can interfere with each other, smearing out any pattern.
To overcome this, the teams studied the light pattern from a single atom. They then created an algorithm which could generate a composite of this pattern from different arrangements of a grid of atoms. By matching these simulations to the actual pattern seen, the algorithm could determine the arrangement of atoms (*Nature*, DOI: 10.1038/nature09378, *Science*, DOI: 10.1126/science.1192368).
Each atom in the lattice would act as a quantum bit. Kuhr says that the optical lattice has many more of these "qubits" than other approaches to quantum computing, and so could offer greater speed.

http://www.newscientist.com/article/mg20727743.900-atom-images-raise-quantum-computer-hopes.html

You don't need brothers or sisters to be sociable

- 20 August 2010
- Magazine issue 2774.

No siblings, lots of friends (Image: Gideon Mendel / In Pictures / Corbis)

THE stigma attached to only children - that they have weaker social skills - is unwarranted. So say Doug Downey and Donna Bobbit-Zeher of Ohio State University, Columbus, who found that kids with siblings make no more friends than those without.

Concerns about poor social skills among children raised alone stem in part from a paper Downey published in 2004, which asked kindergarten teachers in the US to rate the social skills of children, aged around 5, in their care. He found that children with siblings received higher ratings.

But the difference appears to disappear as children age. He and Bobbit-Zeher analysed a survey of 13,500 children from 100 schools around the US. One section required students to name up to 10 friends. Pupils were typically named by five other children, regardless of whether they had siblings or not. Bobbitt-Zeher presented the results this week at the annual meeting of the American Sociological Association in Georgia.

"Only children move up quickly in their professions," says Rebecca Hegar of the University of Texas at Arlington. "It's unlikely they would do that if they didn't interact well with peers."

http://www.newscientist.com/section/science-in-society

How DNA evidence creates victims of chance

- 18 August 2010 by **Linda Geddes**

Magazine issue 2774.

What are the odds that he deserves the cuffs? (Image: Erika Kyte/Photonica/Getty)

Read more: *Fallible DNA evidence can mean prison or freedom*

CHARLES RICHARD SMITH has learned the hard way that you can prove almost anything with statistics. In 2009 a disputed statistic provided by a DNA analyst landed him with a 25-year jail sentence.

Smith was convicted of a sexual assault on Mary Jackson (not her real name) in Sacramento, California, which took place in January 2006. Jackson was sitting in a parking lot when a stranger jumped into her truck and made her drive to a remote location before forcing her to perform oral sex on him. When police arrested Smith and took a swab of cells from his penis, they found a second person's DNA mixed with his own.

The DNA analyst who testified in Smith's trial said the chances of the DNA coming from someone other than Jackson were 1 in 95,000. But both the prosecution and the analyst's supervisor said the odds were more like 1 in 47. A later review of the evidence suggested that the chances of the second person's DNA coming from someone other than Jackson were closer to 1 in 13, while a different statistical method said the chance of seeing this evidence if the DNA came from Jackson is only twice that of the chance of seeing it if it came from someone else.

How can a single piece of DNA evidence generate such massive differences in the statistical weight assigned to it? Last week, a *New Scientist* investigation showed how different forensic analysts can reach very different conclusions about whether or not someone's DNA matches a profile from a crime scene. This week we show how, even when analysts agree that someone could be a match for a piece of DNA evidence, the statistical weight assigned to that match can vary enormously.

"Usually DNA evidence is pretty strong," says David Balding, a statistical geneticist at University College London, whose calculation puts the lowest probability on the link between Smith and Jackson. "My point is that the number juries are provided with often overstates the evidence. It should be a smaller number."

The odds juries are provided with often overstate the evidence

There are several types of statistic that analysts can attach to DNA evidence. In basic cases involving a large amount of DNA from a single person, you can simply calculate how common their profile is in the general population- this is called the random match probability (RMP). However, the RMP becomes problematic when looking at mixed or degraded samples of DNA, where part of a person's DNA profile may be missing or hidden by another person's DNA.

For this reason many labs will use a different statistic when interpreting mixtures, such as "random man not excluded" (RMNE) or the "combined probability of inclusion or exclusion" (CPI/E). These calculate the odds that DNA in a mixture is from a random person rather than the person you're interested in.

But this approach by no means solves the problems. In Smith's case, two of the statistics given- 1/95,000 and 1/47- were the result of RMNE or CPI calculations, while the 1/13 statistic was a variation on these.

A DNA profile consists of a series of peaks relating to specific locations on the chromosomes, called loci. In a standard profile there should be peaks indicating two genetic sequences, or alleles, at every locus- one from each parent. However, in mixed profiles or when only small amounts of DNA are present, it can be difficult to work out which alleles came from whom, and even to detect whether certain alleles are present (*New Scientist*, 14 August, p 8).

In the Smith case, the sample containing another person's DNA showed alleles at seven out of a possible 15 loci, but at four of these loci, the alleles matched those of both the victim and the defendant. "The 1 in 95,000 figure in effect treated these alleles as full-weight evidence that the DNA came from the victim, ignoring the alternative possibility that the allele we saw could have been from the defendant," says Balding. If the opposite position is taken, and these alleles are ignored, you come up with a figure closer to 1 in 13. "It's a question of which loci you consider," he says.

At present there are no firm guidelines on which alleles should be included in an RMNE calculation, meaning that different labs can come up with very different statistics.

Balding and Peter Gill of the University of Strathclyde in Glasgow, UK, who is a former chief analyst at the UK's Forensic Science Service (FSS), have developed a different statistic, the likelihood ratio (LR), which attempts to take phenomena like missing alleles into account. "The likelihood ratio tries to do the right thing," says Balding. "It asks how probable is this evidence under the prosecution case, and how probable is this evidence under the defence case? Then you take the ratio of the two."

Useless at trial

In the Smith case, Balding calculated an LR of just 2, meaning that the DNA evidence is only twice as likely if it came from the victim as from someone else. Since there are many alternative possibilities for the source of the DNA, a 2 to 1 ratio means the evidence is so weak as to be virtually useless at trial.

Yet neither the LR of 2 nor the 1/13 statistic was presented in court. Smith was ultimately convicted on the basis of this DNA and other evidence. He is still in prison, and plans to appeal.

Using a likelihood ratio doesn't necessarily mean that the defendant will get an easier ride. In a 2003 murder case in the UK, Balding's LR found that the evidence was 10 million times more likely to fit the prosecution's case than that of the defence (*Forensic Science International: Genetics*, DOI: 10.1016/j.fsigen.2009.03.003).

"All evidence is worthwhile, it's just a question of can you evaluate it fairly?" says Balding.

These cases are not isolated incidents. A recent study by John Butler at the US National Institute of Standards and Technology (NIST) in Gaithersburg, Maryland, found widespread variation in the statistics reported by individual laboratories. When he gave the same DNA evidence to 69 different US labs and asked them to provide conclusions about whether or not the suspect was a match, some labs reported RMP, others reported

RMNE, while others gave no statistic at all. "There was a difference of about 10 orders of magnitude in terms of the statistical results that were obtained on the same samples," says Butler.
Even among the labs using the same statistic- the RMNE- there were differences in the figure they came up with, depending on which alleles they chose to include or discard. What it could mean is that a jury presented with evidence from one lab is told that the chance of a match is around 1 in 100,000, say, while a different lab might say it is 1 in a quadrillion (10^{15}).

Throwing evidence away

Our own survey of DNA laboratories backs up these conclusions (see chart). We asked 19 labs around the world which statistics they report when dealing with complex DNA mixtures. Six said that they reported RMP, six reported RMNE, while two said they reported LR. Five labs said they either report no statistics or a CPI/E. The type of statistic reported even varied within the same US state.
The International Society for Forensic Genetics recently issued guidelines recommending the use of the LR when dealing with complex mixtures. Even so, few labs have taken it up. The Institute of Environmental Science and Research lab in Auckland, New Zealand, which performs DNA analysis for the New Zealand police, is one of the few to do so. "Likelihood ratios are more complex, and they're harder to present in court," says John Buckleton, head of ESR's biology lab. For this reason, introducing them can require training for judges to ensure they can accurately explain the statistic to jurors.
Even the UK's FSS, where Gill worked for 25 years, has not fully implemented LRs. "They report LRs, but they're not necessarily incorporating things like the probability of [missing alleles]," says Gill. "By not using the proper statistical methods, you're just throwing evidence away." When *New Scientist* contacted the FSS, we were told that it does evaluate DNA evidence using LRs. "In addition," said a spokesperson, "we use the replication method of analysis when dealing with low levels of DNA, which means that the scientist reports the alleles that can be replicated."
Earlier this year, the Scientific Working Group on DNA Analysis Methods (SWGDAM), which provides guidance to US forensic labs, issued its own recommendations regarding the use of statistics for DNA mixtures. It also proposes LR as a suitable statistic, as well as providing stronger guidance on how RMNE and RMP should be calculated. SWGDAM also insists that analysts must provide a statistic whenever they claim that someone's DNA might be included in a mixture. "There are some labs that are just reporting that they think it's a match- in their opinion," says Butler. "That's a problem, because the jury says: 'Oh, it's DNA? It matches? Guilty.'"
Some labs give no statistics on a match, just an opinion. That's a problem
Ultimately though, there will be cases where the DNA evidence is so complex that it is impossible to generate a reliable statistic. Buckleton admits that DNA analysts can come under pressure from prosecutors and police, as well as defence lawyers, to render DNA evidence useable. "I'm not sure that the pressure is to drive the numbers in any particular direction, but perhaps to be more certain than you should be at some points," he says.
In really complex cases, analysts need to be able to draw a line and say "This is just too complex, I can't make the call on it," says Butler. "Part of the challenge now, is that every lab has that line set at a different place. But the honest thing to do as a scientist is to say: I'm not going to try to get something that won't be reliable."

When lawyers question DNA

In 2007, Sean Hoey was cleared of involvement in the 1998 Omagh bombing in Northern Ireland, which killed 29 people. At the heart of the case against him was DNA on the bomb timers, which the prosecution alleged matched Hoey's. It was the first time that defence lawyers had challenged DNA evidence in a UK court, and they were successful, arguing that DNA analysts were divided over the reliability of the technique used. In low-copy-number (LCN) testing, tiny amounts of DNA are amplified to generate a profile.

Since then, much of the scrutiny surrounding DNA evidence has focused on the reliability of LCN testing, but some feel that this emphasis is misplaced.

In the wake of the Hoey case, Belfast-based solicitor Peter Corrigan of Kevin Winters and Company has routinely sought access to the lab reports behind the DNA evidence presented in court, which has resulted in four successful challenges. "The underlying data had never been subject to any court scrutiny," he says. "Defence experts were trusting that the scientists had interpreted the data correctly. This perpetuated the myth that DNA is infallible."

Peter Gill of the University of Strathclyde in Glasgow, UK, a former analyst at the UK's Forensic Science Service, admits that there is a problem. "There's a considerable lack of understanding, not just from the public, but from the judges and lawyers."

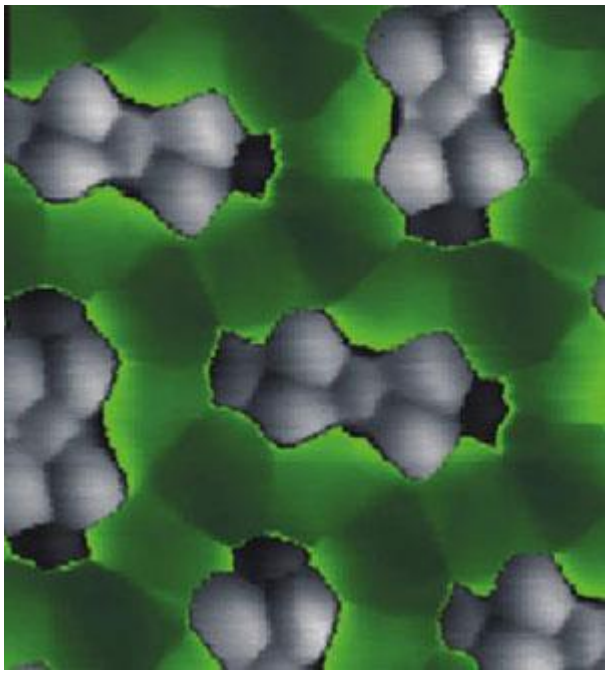
The problem is not confined to the UK. "In our experience, examination of the underlying data frequently reveals limitations or problems that would not be apparent from the lab report," says William Thompson of the University of California, Berkeley, who acts as an expert witness on DNA. However, "forensic DNA analysts tell us that they receive requests [for DNA lab reports] from defence lawyers in only 10 to 15 per cent of cases in which their tests incriminate a suspect," Thompson says.

Even when the defence makes a legitimate challenge, the public rarely hears about it. In the UK, defence lawyers are granted access to DNA data on the condition that they only use it in the case in question. If the questioned evidence is dropped before it gets to court, this never becomes public, says Allan Jamieson of the Forensic Institute in Glasgow.

http://www.newscientist.com/article/mg20727743.300-how-dna-evidence-creates-victims-of-chance.html

Hydrogen bonds are caught on camera

- 09:00 20 August 2010 by **Catherine de Lange**



Enhanced scanning tunnelling microscope image of PTCDA (Image: American Chemical Society)

By affecting the way molecules bind to each other, hydrogen bonds are responsible for water's high boiling point, ice's propensity to float and DNA's signature double helix.

Now these life-enabling bonds – essentially the force of attraction between one molecule's slightly positively charged hydrogen atoms, and negatively charged areas on a neighbouring molecule – seem to have been captured on camera.

Individual atoms can be imaged using a scanning tunnelling microscope (STM). As its sharp-tipped probe scans a surface, the extent to which electrons "tunnel" between the tip and surface indicates changes in height caused by the presence of atoms.

In 2008, Stefan Tautz at the Jülich Research Centre in Germany and colleagues found that the resulting images became sharper if cold hydrogen is present between the tip and the surface.

Intricate detail
Now his team has shown that this allows hydrogen bonds to be imaged too. When they applied the technique to a sample of the flat organic molecule PTCDA, not only did the molecules show up in intricate detail, an electrical signal was also detected between them (coloured green in image), at exactly the locations where hydrogen bonds are present.

"We were absolutely stunned to see this," says Tautz. The next step is to discover what is causing the phenomenon. "It's an open question, and I don't want to speculate," he adds.

Whatever that turns out to be, the imaging technique could have exciting applications. "The images show remarkable intramolecular resolution and greatly advance the investigation of molecular monolayer structures," says Leo Gross, a surface chemist from IBM Research in Zurich, Switzerland.

Designer nanopores

Peter Sloan, a physicist at the University of Birmingham, UK, says that the ability to image hydrogen bonds could, amongst other things, aid the construction of "designer nanopores". These are customisable gaps between self-assembled molecules that are held together by hydrogen bonds, and can enhance catalysis.

"The trick is how to design the self-assembled layer," he says. "Being able to see the hydrogen bonds between molecules will give a better understanding of the 2D bonding and hence allow better, more complex self-assembled structures to be designed and made."

STM only works on flat surfaces, so imaging the hydrogen bonds between more complex, three-dimensional molecules like proteins is not yet possible.

Journal reference: *Journal of the American Chemical Society*, DOI: 10.1021/ja104332t

http://www.newscientist.com/article/dn19339-hydrogen-bonds-are-caught-on-camera.html

Brain training improves acting skills

- 19 August 2010 by **Jessica Hamzelou**
- Magazine issue 2774.

Actors can aid their preparation by using brain training (Image: Alastair Muir/Rex)

SOME actors go to extreme lengths to prepare for a role: Daniel Day-Lewis spent months in a wheelchair to get into character for *My Left Foot*. But if that sounds too much like hard work, actors can now use brain training to prepare instead.

John Gruzelier and colleagues at Goldsmiths, University of London, have used neurofeedback training to improve actors' performance.

In training, each actor watched a simulation of a theatre auditorium, as if on stage, while wearing electrodes on their scalp. The lights and sounds of the simulation were programmed to change in response to the wearer's brain activity. Each actor was told to control their brainwaves to take the lights and crowd noise to a given level. The brain activity needed to achieve this was somewhere between slow-wave activity, associated with sleep, and fast-wave activity, associated with alert wakefulness.

"It's the natural relaxed state of focused attention," says Gruzelier. It's what actors refer to as "listening"; what you need to achieve a Judy Dench-class performance, he adds.

Brain training provides the 'focused attention' that you need to achieve a Judy Dench-class performance

The actors gave various stage performances before and after a series of 10 half-hour training sessions over seven weeks. Footage of their performances was judged by acting professors along several criteria, including vocal expression and fluency. In addition, the actors judged their own performances.

Gruzelier's team found that both the actors and professors' scores were higher after the seven weeks of training compared with a group that received no training over the same period (*Neuroscience Letters*, DOI: 10.1016/j.neulet.2010.06.019).

"The training is pretty similar to relaxation protocols that actors might well be familiar with already," says John Rothwell of University College London. "It's a neat way to quantify it, though."

http://www.newscientist.com/article/mg20727743.500-brain-training-improves-acting-skills.html

Muscle lab: Bulk up with the science of bodybuilding

- 15:31 18 August 2010 by **Jessica Hamzelou**

Heavier doesn't mean better (Image: WestEnd61/Rex)

Looking to beef up? As research sheds new light on how our muscles work, it may be time to scrap old bodybuilding advice. *New Scientist* brings you top tips for the budding Mr Universe.

What is the best way to pump iron?

Standard advice for gym bunnies is to lift as much weight as you can in a training session. But Stuart Phillips and his team at McMaster University in Hamilton, Ontario, Canada, reckon this might not be the best way to build muscle. Instead, they suggest that slow and steady wins the race.

In Phillips's study, men in their early 20s lifted weights with their legs over various periods at 30 and 90 per cent of the maximum weight they could lift. Phillips analysed biopsies from the leg muscles before and after each training session.

He found that the production of new muscle proteins was greatest when the men were lifting the relatively light weights – at 30 per cent of their maximum – until they were fatigued, and couldn't lift any more.

The idea that you should lift progressively heavier weights to bulk up is "completely false", says Phillips. Instead, the best way to build muscle is to lift more manageable weights until you tire out, he says.

Is it easier to rebuild lost muscle than start from scratch?

The phenomenon of "muscle memory" is a handy one for muscle buffs who take extended breaks between workouts. The idea is that once a person has acquired a certain level of strength for the first time, they will find it easier to reach that point again, even if they allow their muscles to waste away in the meantime.

Kristian Gundersen and his colleagues at the University of Oslo in Norway reckon the explanation lies in the fact that muscle undergoes permanent changes during training.

To investigate, Gundersen's team cut the synergist, or "helper", leg muscles in one leg in mice, thereby increasing the amount of work for the remaining muscle. After two weeks, the group found that the number of nuclei in the fibres of the remaining muscle had increased by 37 per cent.

This bulked-up muscle was then left to waste by cutting off its nerve supply. However, three months later – equivalent to around 10 human years – the increased number of nuclei remained within the muscle fibres.

Because the nuclei of muscle fibres are key to the production of new muscle protein, Gundersen thinks that after a bout of training, the potential to grow muscle sticks with you for life. So no matter how much time has passed since you were in the peak of muscular fitness, it should be easier to achieve the second time around.

What about steroids?

Anabolic steroids are thought to work by increasing the number of muscle cell nuclei. "If those effects are also permanent, the effects of one-time doping could last forever," says Gundersen. "We may need to reconsider how long the exclusion period should be for an athlete caught taking steroids."

What's that burning feeling a day or two after a workout?

The ache you feel a couple of days after particularly intensive exercise is known as "delayed onset muscle soreness". It is thought to be caused by the lengthening and subsequent damage of muscle fibres during strenuous stretches. Damaged muscle cells can die off, causing inflammation and pain. Muscle builders take note: overly arduous workouts could work your muscles into oblivion.

What's the ideal diet for a bodybuilder?

It is important to get enough protein in your diet, from foods such as red meat and eggs, as amino acids are essential for making new muscle proteins. In a 2004 paper, Charles Lambert, then at the University of Arkansas in Little Rock, and colleagues recommended that protein make up 25 to 30 per cent of a bodybuilder's diet.

During exercise, most of the energy for muscle work comes from carbohydrates that have been broken down into glucose and converted to glycogen. Lambert's team reckoned carbs should make up around 55 to 60 per cent of a bodybuilder's energy intake.

Before a photo shoot, some male models are known to go to drastic lengths to look their most buff. A pre-shoot drinking binge dehydrates the skin, so it is pulled taut over the muscles to accentuate them. A healthier way to look your best would be to cut fat intake, says Phillips.

But cutting out too much fat could be a mistake. Lambert thinks fat should make up around 15 to 20 per cent of total energy intake. Reducing fat in the diet is known to reduce circulating levels of testosterone, which is thought to boost muscle mass and limb strength.

Journal references: Phillips, *PLoS One*, DOI: 10.1371/journal.pone.0012033; Gundersen, *Proceedings of the National Academy of Sciences*, DOI: 10.1073/pnas.0913935107; Lambert, *Journal of the American Geriatrics Society*, DOI: 10.1111/j.1532-5415.2008.01927.x

http://www.newscientist.com/article/dn19330-muscle-lab-bulk-up-with-the-science-of-bodybuilding.html

Hair gives clues to circadian rhythms

- 20:00 23 August 2010 by **Stephen Battersby**

Your hair can tell the time on your body clock (Image: Steve Gschmeissner/SPL)

Worried that your lifestyle might be at odds with your body clock? A bit of hair is all you need to check.
Biochemical activity operates to the circadian rhythm, a cycle lasting roughly 24 hours. It coordinates sleep patterns, hormone production, immune responses and tissue repair, and is normally kept fine-tuned by doses of daylight.
A disturbed circadian rhythm can lead to sleep deprivation and has been linked to an increased risk of developing certain diseases, including cancer.
The rhythms are maintained by a set of genes whose activity can be monitored via their production of messenger RNA molecules.
Makoto Akashi of Yamaguchi University in Japan and colleagues found that five head hairs or three beard hairs provided enough cells to monitor mRNA levels and pin down an individual's circadian rhythm.

Shift work

The team used this technique on workers who alternated between weeks of day and night shifts over three weeks. Although their sleep pattern shifted by 7 hours each week, the tests showed that their body clocks moved back and forth by 2 hours at most.
Akashi says that the hair test could provide a simple way to monitor these rhythms and so avoid diseases linked to a disturbed body clock.
Journal reference: *Proceedings of the National Academy of Science*, DOI: 10.1073/pnas.1003878107

http://www.newscientist.com/article/dn19349-hair-gives-clues-to-circadian-rhythms.html

Cancer muscle loss might be reversible

- 18:18 23 August 2010 by **Jessica Hamzelou**

One injection may be all that is needed to reverse muscle wasting in cancer, if an experimental technique used in mice can one day be made to work in people.
Like humans, mice with cancer experience severe muscle wasting. Mice with colon cancer studied by HQ Han and colleagues at Amgen Research in California stopped eating, and lost 20 per cent of their body weight in three weeks.
Many tumours produce a molecule called activin, which plays a role in muscle breakdown. So Han and his team injected a protein that mops up excess activin, five or 14 days after mice were implanted with a colon tumour. In both cases, the mice started eating and their body weight returned to normal within two weeks. Mice with gonad tumours responded in a similar way.
The treatment also led to the mice surviving longer. By the time all the untreated mice had died, around 90 per cent of the treated mice were still alive. "The findings highlight the importance of preserving muscle mass for survival," says Kate Murphy at the University of Melbourne.
Journal reference: *Cell*, vol 142, p 531

http://www.newscientist.com/article/dn19352-cancer-muscle-loss-might-be-reversible.html

Autism explosion half explained, half still a mystery

- 13:40 16 August 2010 by **Jim Giles**

More illumination needed (Image: Canadian Press/Rex Features)

Why have the numbers of autism diagnoses ballooned in recent decades? Researchers have long claimed that changes to the way the condition is diagnosed are the main cause. But now a series of a studies have shown that diagnostic changes alone cannot account for the increase. They suggest that other causes, perhaps environmental factors, are also contributing to the rise in cases.

"These studies give me the feeling that there must be a true increase in the number of children affected," says Tom Insel, director of the National Institute of Mental Health in Rockville, Maryland.

The studies are the work of sociologist Peter Bearman at Columbia University in New York and colleagues. They have spent three years trying to disentangle the causes of the roughly sevenfold increase in autism rates seen in many developed nations over the past 20 years. They have identified three factors that are driving up autism rates, but found that these account for only half of the observed increase.

Better diagnosis

Diagnostic changes are the most important influence. After 1987, the definition of autism used in California was broadened several times. Bearman and his colleague Marissa King examined the medical records of around 7000 Californian children with autism and found that one in ten had initially been diagnosed with mental retardation. Extrapolated to the state as a whole, they estimate that this change in diagnosis created almost 5000 extra cases of autism between 1993 and 2005, or 26 per cent of the increase of recorded over that period.

Greater awareness

Social influence accounts for another big chunk of the overall increase. Parents are more aware of the disorder than they used to be, and so those whose children who have mild forms of autism have become more likely to seek out diagnosis.

Bearman and his colleague Ka-Yuet Liu quantified this effect. They first estimated how the chances of a child being diagnosed with autism increase if he or she lives close to a child that has already been diagnosed. They then plotted the addresses of children with and without autism in California to calculate the number of children who had grown up close to a child diagnosed with the condition. They were then able to calculate the fraction of extra cases that would have been diagnosed as a result of social interactions. They put this figure at 16 per cent.

Older parents

The final contribution to the rise in diagnoses comes from demographics. Couples in California are having children later in life, as they are in much of the rest of North America and Europe. That is pushing up autism rates, because autism is triggered by genetic mutations that older parents are more likely to pass on to their children.

Bearman and King calculated that these older parents are responsible for 11 per cent of the extra autism cases.

Missing a piece of the puzzle

Autism experts say Bearman's work is notable because it provides a powerful overview of the potential causes. "Bearman is giving us the answers we've been looking for," says Michael Rosanoff at Autism Speaks, a New York-based charity that funds autism research.

Not all the answers, however. Together, the three effects account for roughly half the extra cases. So what is behind the other half? "I wish we knew," says Rosanoff. "There are many factors being explored, but not one leading theory." Childhood vaccines, which some parents blame for the increase, have been ruled out by epidemiological studies.

Insel says that environmental factors are most likely to be behind the rise, although research to pin down which are to blame will take years.

But other researchers caution against this assumption. Autism used to be highly stigmatised, in part because it was thought to be due to poor parenting. The removal of that stigma has made doctors and parents more willing to recognise the disease, which will have contributed to [some of] the extra cases, says Roy Grinker, an anthropologist at George Washington University in Washington DC.

This and other social causes, together with uncertainty in the number of cases that can be attributed to the factors already studied by Bearman, could account for much or all of the unexplained half, says Grinker.

Journal references: Bearman and King: *International Journal of Epidemiology*, DOI: 10.1093/ije/dyp261; Bearman and Lui: *American Journal of Sociology*, DOI: 10.1086/651448; Bearman and King: *American Journal of Public Health*, DOI: 10.2105/ajph.2008.149021

http://www.newscientist.com/article/dn19316-autism-explosion-half-explained-half-still-a-mystery.html

Resurrecting the Dead Sea

An extraordinary plan to revive the Dead Sea could ease tensions among Israel, Palestine and Jordan. Or it could create an environmental disaster.

By Vince Beiser

The Dead Sea, a storied feature of the landscape since at least biblical times, is drying up. (Naftali Hilger)

Fathi Huweimel leans carefully over the edge of a jagged slab of broken asphalt, peering down into a 60-foot-deep crater that was level ground just yesterday. All around him sprawl the ruins of Ghawr al Hadithah, once a farming village in central Jordan but now a jigsaw of broken houses, shattered roads and abandoned tomato fields growing wild amid the massive holes pocking the earth. To the east, the village gives way to desert fringed by stark, sere mountains. To the west, a few hundred yards away, lie the glimmering waters of the Dead Sea.

"We've had about 75 holes open up in the last two years," says Huweimel, a thickset man with a broad mouth and deep brown eyes who has lived all of his 45 years in the area. He works as a field researcher with Friends of the Earth-Middle East, an environmental organization. "Everyone is leaving," he continues. "Those who stay are staying because they have no choice."

The holes first started appearing in the 1980s, but the pace at which new ones open up has increased dramatically in recent years. Miraculously, no one has been killed by a cave-in yet, though there have been some close calls. A group of seven women — including Huweimel's aunt — were harvesting tomatoes

together one day when the ground collapsed with a roar just 2 meters in front of them. A small salt factory that employed about 100 people was evacuated before it collapsed.

The cause of all this destruction is water — or, rather, the lack of it. The ground is collapsing into sinkholes because the water beneath it is retreating. And the water is retreating because the Dead Sea, a storied feature of the landscape since at least biblical times, is drying up.

In This Issue

Lobbying doesn't usually work; fat won't kill you; and the Dead Sea doesn't need to die. Check out those stories, our cover story on oxytocin shaking up the field of economics and much more in the September-October 2010 issue of *Miller-McCune* magazine.

The sea — actually a huge lake straddling the Israeli-Jordanian border at the lowest point on Earth, 420 meters below sea level — has been fed for millennia by the Jordan River. But today, so much water is siphoned out of the Jordan to feed farms and cities that practically nothing is left to replenish the Dead Sea.

Over the past three decades, the sea's level has fallen by some 25 meters and continues to drop by an average of another meter every year. Its surface area is dwindling apace; the sea's shore has retreated as much as a mile. That is dealing a severe blow to the hotels and spas dotting what used to be the sea's beaches. Moreover, as the water retreats, it destabilizes the ground around it, spawning the sinkholes that have devoured Ghawr al Hadithah. Underground freshwater springs that feed nearby oases rich in wildlife are also being dragged down.

"It's a time bomb," Huweimel says. "It will only get worse if nothing is done."

It's an extraordinary problem that has generated an extraordinary response. The governments of the three peoples that live along the Jordan River and the Dead Sea — the Israelis, Jordanians and Palestinians — are working together to promote a potential solution: a conduit to bring ocean water from the Red Sea to the Dead Sea. It's being touted as a triple win: The water would replenish the Dead Sea, and in the process generate hydroelectric power, which would in turn run desalination plants to make potable water for the region. As a not-inconsiderable political bonus, it would constitute the first major project ever undertaken by all three nations.

There's just one problem. The conduit might make things even worse.

One morning in late spring, Gidon Bromberg, Israeli director of Friends of the Earth-Middle East, takes me to the Lido Café at the northern end of the sea on the Israel side. For decades, the Lido was an elegant open-air restaurant where well-heeled residents of Jericho and Jerusalem would come to have a leisurely lunch, smoke *nargileh* water pipes and step right off the patio for a dip in the Dead Sea. Today, weeds push through the patio's broken tiles, and paint is peeling off the parts of the walls that are still standing. A hunched, leafless tree sulks by steps that once led to the water but now stop abruptly 3 feet above trash-strewn desert. The Dead Sea is barely visible in the distance, across a half-mile of bare, dun-colored earth.

"This place died because the Dead Sea ran away," says Bromberg, an athletically built Israeli lawyer who still speaks with a trace of an accent betraying his boyhood in Australia. He's looking slightly disheveled

today in a rumpled polo shirt, his short hair uncombed. Bromberg knows this area like he knows the neighborhood in Tel Aviv where he lives. He's been bringing legislators, activists, journalists and pretty much anyone he can get interested out here for more than a decade now to witness the crisis facing the Dead Sea.

Bromberg, 46, founded Friends of the Earth-Middle East in 1994, in the heady days after Israel and the Palestinians signed the Oslo accords, when it seemed that peace might finally be within reach. As thrilling as that prospect was, Bromberg also saw a potential downside, one which he investigated in his master's thesis at the American University in Washington, D.C. "I concluded that the peace process would contribute to the demise of the environment," Bromberg says. "It was all about building hotels, industrial estates and highways. There was no discussion on improving or even protecting the environment."

That finding inspired him to seek out like-minded Jordanian and Palestinian activists to help create FoEME, the first civil organization to bring representatives from all three peoples together in common cause. The idea was to address environmental issues that cross borders, water chief among them.

Of course, the region's bitter politics haven't made things easy. Within a few years of the group's founding, the peace process collapsed into the bloody second Intifada. With the body count of both Palestinians and Israelis rising daily, anyone working with the other side risked being seen as a traitor. Bromberg's car tires have been slashed, his Jordanian counterpart has been shot at, and Palestinian FoEME workers have been kidnapped by hard-line militias — but the group has not only survived, it has grown and now boasts 50 paid staff and offices in Tel Aviv, Bethlehem and Amman. Funding comes from the U.S. and European governments as well as private foundations. *Time* magazine declared the group "environmental heroes" in 2008, and last year the Skoll Foundation gave it an award for social entrepreneurship. "I don't accept everything the Israeli government does, but there has to be a dialogue between the people," says Baha Afaneh, a Palestinian who works in FoEME's Amman branch. "We're trying to work together on issues that affect us all."

Saving the Dead Sea was the very first project the group took on. "We did an inventory back in 1995," Bromberg says, "and we saw that the Dead Sea faced the gravest threat."

The Dead Sea earns its name from the composition of its waters, which are so dense with minerals and salt — 10 times as much as ordinary seawater — that nothing but microbes survives in them. The sea has no channel out. Water comes in mainly from the Jordan River and leaves by evaporating under the sweltering desert sun, which routinely drives temperatures up to 120 degrees.

For thousands of years, that input/output equation remained more or less in balance. But in recent decades, the region's booming population has thrown it completely out of whack. Jordanians, Palestinians and especially Israelis pull so much water from the Jordan that only a heavily polluted trickle now reaches the Dead Sea from the north. Meanwhile, at the sea's southern end, enormous factories pump out water to extract minerals. What's left behind in the sea is evaporating as fast as ever, but almost no new water is coming in to replenish it.

The Dead Sea has shrunk before. Throughout its long history, there have been low-rainfall years that reduced the Jordan River to a dribble. "The sea has been even lower than it is today in previous centuries, but it would always come back when precipitation picked up," Bromberg says. "The difference today is that the Dead Sea is on a one-way ride. It can't come back as it has before."

The sea is unlikely to ever disappear completely. Small underground springs and rain provide enough water that even if the Jordan were to dry up altogether, the sea would eventually stabilize — but as an ultra-briny puddle of about one-third its original size. If that were to happen, it would mean the loss of a world historic site and incalculable damage to the region's economy and ecology.

Tourists flock to the area from all over the world for the spectacular desert scenery and history. Masada, the mountaintop fortress where Jewish zealots held out for years against conquering Romans, is nearby, as is the cave where the Dead Sea scrolls were found. But the main attraction is the sea itself, with its mineral-rich, ultra-salty waters, which are reputed to have therapeutic powers and offer the giddy experience of effortless floating.

But it gets harder every year for visitors to actually reach the water. When Israel's Ein Gedi Spa, a health-tourism complex offering massages and sulphur pools, was built in the 1980s, the Dead Sea came right up to the wall around its outdoor swimming pool. Now, guests have to ride a tractor-pulled tram through a mile of mud flats to reach the constantly receding shore.

And as the water retreats, more and more sinkholes open up. Kibbutz Ein Gedi, which runs the spa, has had to close a nearby campground because half of it has been swallowed up by the earth. Sinkholes have also made it too dangerous to work a date plantation across the road, where the palms have been left to dry up and double over on themselves, as though they've abandoned hope. The sinkholes have also forced the Israeli government to scrub plans for 5,000 new hotel rooms in the area. All told, the Dead Sea's shrinkage is costing Israel some $60 million per year in lost tourism revenues, according to an estimate by the Samuel Neaman Institute, an Israeli public policy research outfit.

Eli Raz knows more about the sinkholes than anyone. Raz is a sinewy, silver-haired Ben-Gurion University geologist who lives at Kibbutz Ein Gedi, where he works out of a windowless office surrounded by glossy photos of desert rocks, flowers and salt formations. He has been studying the holes since they first started appearing in the late 1980s. A few years ago, on one of his regular research expeditions, he fell into a 30-foot sinkhole and was trapped for 14 hours until rescue workers pulled him out. "Now I have documented sinkholes from the inside as well as out," Raz deadpans.

Raz estimates there are more than 3,000 sinkholes just on the Israeli side. They are the result of a shift in underground currents caused by the sea's drop. Subterranean Dead Sea water has built up a layer of salt rock under the soil in many areas. As that water withdraws, new water takes its place, slowly dissolving the salt layer — until the ground above gives way.

Sinkholes are just one side effect of the shift in the underground water flow. As the groundwater chases the receding seawater, it is changing the course of the underground springs that feed nearby oases. Sizeable swathes of vegetation are dying as a result. That threatens the ibex, leopards and other rare animal and plant species that live in the oases, as well as the hundreds of millions of birds that stop to rest in them on their migration routes.

"If you disturb this ecosystem, it could have a big chain reaction," Raz says. "That's my biggest concern."

But concerned as he is about the damage being done by the Dead Sea's shrinkage, Raz is deeply skeptical of the plan to save it by bringing in water from the Red Sea.

The idea of digging a waterway from the ocean to the Dead Sea has been bandied about for centuries. Athanasius Kircher, a renowned German-Jesuit scholar, proposed it in 1664 as a transportation route; an English admiral named William Allen seconded the notion in 1855. Theodor Herzl, the founder of Zionism, imagined a canal from the Mediterranean to the Dead Sea in his seminal 1902 book *Altneuland* (The Old New Land).

The Israeli government took a serious look at digging a canal in the 1970s and 1980s, hoping it could yield hydroelectric power that would leave the country less dependent on foreign oil. But the Red-to-Dead project really began gathering steam in the 1990s, amid the exuberance of peacemaking between Israel, Jordan and the Palestinians. Former Israeli Prime Minister Shimon Peres is the idea's foremost champion. In his book, *The New Middle East*, Peres writes:

"Politically, this earthshaking enterprise can help maintain peace and establish mutual long-term interests. … The water will flow along the Arava (the desert valley in which the sea sits), the power stations will give light, and the wasteland will bloom with life. The region will experience peace, serenity and progress. People from other countries will use the seaport and airport, visit the spas and vacation centers and enjoy the products of our flourishing desert."

The second Intifada bumped the Red-Dead project to the back burner, but finally, in 2006, the governments of Israel, Palestine and Jordan jointly convinced the World Bank to get on board. Everyone involved agrees saving the sea is a priority, but each side gives different weight to the project's other expected benefits. For Jordan, which faces a chronic and deepening shortage of water, developing new, potable supplies is paramount. For Israel, a major engineering project in partnership with an Arab country would constitute a long-sought political milestone. The mere fact that it and its Arab neighbors are talking about such an undertaking earned the participants a pat on the head from the U.S. Senate, which passed a resolution in 2007 applauding "the cooperative manner" in which all three sides were working to save the Dead Sea. For the Palestinians, who were originally excluded from the planning for the conduit, it's crucial just to be given a role in the project, to bolster their political standing in general and their claims to the region's water resources in particular. "Though we are occupied by Israel, the Jordan River runs along our land," as does part of the Dead Sea, says Shaddad Attili, head of the Palestinian Water Authority. "It's important that we be brought in as partners."

The World Bank has rounded up $16.7 million from the U.S., France, Sweden and other countries for a series of studies on the feasibility and environmental and social impacts of what is now formally known as the Red Sea-Dead Sea Water Conveyance Study Program. The project could ultimately take any of several forms — a canal, a tunnel, a pipeline or some combination. In any case, the engineering is fairly straightforward. Red Sea water would have to be pumped over or piped under the hills around Aqaba, Jordan's sole port, which offers the most promising access point to the Red Sea. But after that, it would simply flow downhill to its sub-sea-level destination. Hydroelectric stations along the way would harness the flow to generate power for desalination plants. Estimated cost: anywhere from $5 billion to $15 billion.

And that's the just the basic version. Peres and Israeli industrial magnate Yitzhak Tshuva want to take things even further by building a Vegas-style strip of desert resorts along the waterway. At a recent conference in Jerusalem, Tshuva presented a plan to line the conduit with parks, lagoons, entertainment centers and 200,000 hotel rooms.

It sounds great: Save the Dead Sea, get freshwater, promote regional cooperation, maybe even generate thousands of jobs. But Friends of the Earth-Middle East and other environmental groups are deeply concerned that the conduit might do more harm than good.

There are potential problems all along the route the water would travel. The conduit would suck as much as 2 billion cubic meters — or a little more than half a trillion gallons — of water every year out of the Gulf of Aqaba, a narrow finger of the Red Sea. Pulling out that much water could alter the currents and temperatures in the Gulf, warns the Samuel Neaman Institute, potentially harming the highly sensitive coral reefs and the 1,000-plus species of fish that live there. Those reefs are a world-class diving destination; losing them would certainly cost Jordan some of the nearly half-million visitors that come to Aqaba every year. The massive, noisy machinery required to pump the water out certainly won't help the tourist trade, either.

The waterway is planned to run through the Arava Valley, which sits on the border between two tectonic plates. That makes the area prone to earthquakes that could damage the conduit and send salt water spilling into the surrounding desert, which is home to rare palm trees, gazelles, hyrax and other species. "It's a totally unique ecosystem," Bromberg says. "We're not so worried about a rupture — that would be a one-time thing. It's a consistent leak that is the biggest worry. They're going to be moving nearly 2 billion cubic meters of water through here every year. A leak would mean a constant slow seep of a lot of water."

Mixing regular seawater with that of the Dead Sea, which has a different chemical composition, could also be bad news. Research by the Geological Survey of Israel suggests that the Dead Sea's calcium-rich brine could react with sulphates in the seawater to form gypsum, which would turn the Dead Sea white. The influx of less-salty water could also stimulate the Dead Sea's microorganisms, causing an algae bloom that would turn the water red. And diluting the sea's salinity would likely also reduce its famous buoyancy.

"We think the solution is dealing with the root causes of the sea's demise," Bromberg says, "not some technological fix that will give rise to a new set of problems."

The main cause shrinking the Dead Sea is the emaciated, immiserated Jordan River. In 1847, the Jordan was so big and wild that U.S. Navy Lt. W.F. Lynch had to battle rushing rapids and waterfalls on an exploratory expedition down the river to the Dead Sea. Today, the storied waterway, featured in the holy books of Judaism, Christianity and Islam — the river "deep and wide" in which John baptized Jesus — creeps into the Dead Sea as a trickle composed mostly of sewage. According to a FoEME study released in May, the river's annual inflow to the sea has been squeezed from 1.3 billion cubic meters to an estimated 20 to 30 million cubic meters — a 98 percent drop.

People are to blame. Since 1970, the combined population of Israel, Jordan and the Palestinian territories has more than tripled from 5.3 million to some 17 million. Over the last several decades, they, along with their neighbor to the north, Syria, have tapped, dammed and diverted almost all of the water in the Jordan and the springs and tributaries that once fed it.

Originating in the mountains between Israel and Syria, the river runs down into the Sea of Galilee and from there through the Jordan Valley to the Dead Sea. But Israel and Jordan now take so much water out of the Sea of Galilee that almost none flows out into the riverbed.

About a half-mile south of the Sea of Galilee, what little river water does escape comes up against an earthen berm, forming a large pool rimed with scum and trash. Five fat green pipes angle down into the pool, sucking out water for nearby banana and avocado fields. A little water slips out through a submerged conduit,

emerging as a trickle on the other side of the berm. Into that trickle from another pipe gushes a feculent, gray-green stream of sewage. Signs in English, Hebrew and Arabic warn: “Danger! Don’t enter or drink the water!” It flows away downstream, where it is augmented by more sewage, agricultural runoff and fish pond refuse — the whole mess reconstituted as the sacred waters of the Jordan River.

About 120 kilometers to the south is the spot where Jesus was purportedly baptized. Thousands of devout tourists come to this tranquil patch of reed-lined riverbank every year to follow his example. On a hot day in spring, a black-cassocked Greek Orthodox priest holds the hand of Kristin Londal, a 40-year-old Bible studies teacher from Bronxville, N.Y., as she steps down from a wooden platform into the sluggish green-brown water. She’s dressed in a plain white robe. Holding her nose shut, Londal submerges herself three times.

“Yes, I know the river is polluted. Jesus will keep me clean!” she tells me afterward, standing on the platform dripping and radiant. “But,” she adds, “I will take a shower tonight.” As we talk, a water-rat the size of a small dog pops its head up and swims calmly past.

Israel and Jordan are taking steps to clean the river — but they may strangle it in the process. Wastewater treatment plants are being built on both sides to capture and recycle the sewage before it hits the Jordan. That’s certainly progress. But the FoEME study warns that if that sewage water isn’t replaced with anything, “the Lower Jordan River is expected to run dry at the end of 2011.”

The most obvious way to get more water is desalination, a technology in which Israel leads the world. But desalinating enough water from the Mediterranean to take care of the towns and farms that rely on the Jordan would be tremendously expensive, and would also require large amounts of greenhouse-gas producing energy. There has also been talk of somehow bringing in water from Turkey, another major undertaking.

Bromberg, however, maintains that at least a third of the Jordan’s flow can be restored by using existing water resources more wisely. For starters, if both Jordan and Israel reduced their subsidies to agriculture, they could wean themselves off the unsustainable habit of farming water-intensive export crops in the desert, he says. That’s already starting to happen, but only to an extent. “We’ve had to destroy a lot of trees in the last few years because of the lack of water,” says Yuval Malka, a spokesperson for Kibbutz Kinneret, an agricultural settlement near the Sea of Galilee. “We plant fewer bananas, avocados and mangos.” But he balks at the notion of getting rid of them altogether. “Bananas pay good,” Malka says. “We made nearly a million dollars from them last year.”

Other decidedly unsexy proposals for reducing the amount of water drawn from the Jordan and Sea of Galilee include replacing water toilets with composting ones. “It’s a lot of tiny fixes,” Bromberg says. “That’s the problem; no one’s going to get rich from restoring the Jordan. Politicians are more attracted to grand projects that will leave a mark on history — and make their friends a lot of money.”

Beyond the Jordan, FoEME is pressing to reduce the water used by the massive mineral-extraction works at the southern end of the Dead Sea. On both sides of the border, these companies channel Dead Sea water through a system of broad, winding canals into a 150-square-kilometer expanse of shallow evaporating pools. There, potash, bromides, magnesium and salt are extracted by floating harvesting machines.

The minerals are then taken to a vast industrial park just south of where the story of Sodom and Gomorrah supposedly took place. There’s nothing biblical about the landscape now, though. The desert is buried under a massive sprawl of multistory steel scaffolds, conveyor belts, chutes, pipes and power lines. Gray smoke

billows skyward from towering chimneys while roaring trucks and toploaders shuffle between mountainous heaps of raw white potash.

This industry is responsible for some 40 percent of the Dead Sea's water losses, according to the World Bank. Bromberg says they could cut that substantially if they extracted minerals by pushing the sea's water through membranes, rather than by evaporating it. That would save water — but would be more expensive.

In any case, even if the river were restored and the mineral industry reined in, Jordan would still need more water. The conduit offers the best fix for that and the Dead Sea, its supporters argue. "The environmentalists want to let the Jordan water all flow back, but this is utopian. In my opinion, the conduit is the only valid solution," says Elias Salameh, a University of Jordan hydrologist who has studied the Dead Sea problem extensively. "Of course, it will have bad environmental impacts. We should study and try to minimize them. But the benefits will be far greater."

If the conduit could also significantly improve relations between Israel, Jordan and the Palestinians, as supporters like Salameh argue, it might even be worth a certain amount of environmental damage. Israel's peace with Jordan is reasonably sturdy but could use reinforcing. Israel's relations with the Palestinians, on the other hand, fluctuate between bad and appalling. Resolving their conflict would be a boon to the whole world. Israeli and Palestinian politicians and even French President Nicolas Sarkozy claim the conduit will help."This project brings hope to the region," Attili says. "Despite all the crisis and conflict, we are talking to each other and working together."But the World Bank's most recent assessment of the project's potential political implications, released in May, is only guardedly optimistic on this score.

"The magnitude of the [conduit project] is such that regular and close coordination will be necessary. … This will bind the parties together in mutual dependency, which can only promote better understanding and ties," the report says. However, it continues, "the relationships between Israel and the Palestinian Authority are dominated by political realities. … Implementation of the [project]… will not, of itself, affect these issues." The report projects only "minor to moderate positive impacts" on the political front.With all this in mind, the World Bank recently launched another study, this one examining alternatives to a Red-to-Dead canal or pipeline, including a restoration of some flow to the Jordan River and a water conveyance from the Mediterranean. The whole suite of World Bank studies is scheduled to be completed in June 2011.

In the meantime, however, Jordan plans to start its own, separate project, which would pump Red Sea water to desalination plants near Aqaba and channel the leftover brine to the Dead Sea.Alex McPhail, the World Bank's study program manager for the Red-Dead conduit, claims the bank is not concerned about Jordan going ahead with this project before the bank's studies have been completed. "We're talking about 2 billion cubic meters of water in our project," McPhail says. "They're talking about a fraction of that amount. And the Jordanians have assured us our studies will be done long before they turn the first shovel on their project."

Whether it will save the Dead Sea or damage it further, however, neither project will have any impact at all for a long time. Each will take an estimated 20 years to complete. In the meantime, the sinkholes devouring the fields of Ghawr al Hadithah and Kibbutz Ein Gedi will keep multiplying. The mud flats in front of the tourist hotels will keep growing. And the Dead Sea will keep slipping further and further away from us all.

http://www.miller-mccune.com/environment/resurrecting-the-dead-sea-20011?utm_source=Newsletter123&utm_medium=email&utm_content=0824&utm_campaign=newsletters

Charles Harvey: Water Detective

Charles Harvey traces the source of widespread arsenic poisoning in Bangladesh, setting the stage for programs that could benefit 20 million people.

By Jennifer Weeks

As Charles Harvey sees it, arsenic contamination in Bangladesh is an example of a larger problem occurring in many places around the world. (Gale Zucker)

When a new U.S. president takes office, the first official announcements often undo policies set under the previous administration. In 2001, for example, President George W. Bush notoriously suspended a new standard for arsenic in drinking water that had been announced late in the Clinton administration. The new rule cut the allowed level of arsenic from 0.05 micrograms per liter of water to 0.01, bringing the U.S. in line with the European Union and the World Health Organization.

Arsenic was known to cause cancer, but the earlier limit had been considered safe for decades. Under Clinton, however, the Environmental Protection Agency concluded that arsenic probably was carcinogenic even at extremely low doses.

When Bush's EPA suspended the new standard, environmental and public health advocates erupted. Facing lawsuits, a barrage of bad press and a National Academy of Sciences report concluding that even the Clinton standard might not be strict enough, the Bush administration backed down.

The debate made national headlines for months, but hardly anyone mentioned a glaring fact: Millions of people in developing countries drink groundwater contaminated with much higher levels of arsenic than the old U.S. standard, every day. The problem is especially acute in South Asia, where large rivers — the Mekong, Ganges and Irrawaddy, among them — carry arsenic-rich sediments down from the Himalayas. In 1998, the British Geological Survey estimated that 20 million to 30 million people in Bangladesh alone relied on water containing more than 0.05 micrograms of arsenic per liter. In 2002, the World Health Organization called Bangladesh's arsenic crisis "the world's largest mass poisoning of a population in history."

Cruelly, Bangladeshis were getting sick because they followed the advice of international development agencies. In the 1970s, those agencies advised people in rural Bangladesh to drill "tube wells" — deep shafts made by driving a tube into the earth — for drinking water to avoid the waterborne diseases that had historically plagued the area. By the time scientists realized that much of the country's groundwater was laden with arsenic, villagers were already showing telltale signs: blotchy skin, sores and elevated rates of skin cancer. Many will develop lung, bladder, liver or kidney cancer in the next 10 to 20 years.

There are ways to manage arsenic in drinking water: You can filter the water, treat it with chemicals, harvest rainwater or tap into cleaner aquifers. But to choose the right strategy — especially in developing countries where few people can afford or maintain complex technical systems — it's critical, first, to find the source of the contaminant. After a decade of painstaking scientific detective work, MIT civil engineering professor Charles Harvey found arsenic in an odd place.

Harvey was a junior professor of environmental engineering, specializing in hydrology, when he first learned about drinking water contamination in the Ganges Delta. Hardly anyone in his field was paying attention to the issue, but Harvey had written a dissertation on the movement of dissolved substances through aquifers. He'd also spent a year in medical school before switching to engineering and understood that the contamination represented both an important public health problem and an interesting scientific puzzle.

"Most people who cared about it were talking about quick solutions, but I wanted to understand why arsenic concentrations in the water were so high," says Harvey, who has been a faculty member at MIT for more than a decade but looks boyish enough to pass as a doctoral student. His cluttered office in the university's Parsons Laboratory has a view of MIT's newest campus landmark, a hyper-modern student center designed by Frank Gehry. But the Parsons building is old-style MIT — a concrete shoebox seemingly designed to mask the complexity of what goes on inside.

In 1999, Harvey convinced Shafiqul Islam, an MIT alumnus from Bangladesh who was teaching engineering at the University of Cincinnati, to visit Bangladesh with him to set up a study. They went without funding in hand, which Harvey admits was "kind of crazy." Graham Fogg, a professor of hydrology at the University of California, Davis, agrees but says the venture is to Harvey's credit. "It's really hard to mobilize and do that kind of project across the world, and Charlie did it at a time in his career when his focus was supposed to be on basic research in the laboratory," Fogg says. "He's very unassuming, but he wasn't afraid to follow through on a project that he thought was important."

Harvey and Islam found a research site, made contacts at the Bangladesh University of Engineering and Technology and gathered preliminary data. The next year, they received a National Science Foundation grant to characterize where the arsenic in underground water was coming from. Munshiganj, the district where they worked, is in central Bangladesh and one of the country's most important rice-growing zones. Lying at the intersection of the Ganges, Brahmaputra and Meghna river floodplains, Munshiganj is flooded from July through November during monsoon season.

"The whole place is under water, so people dig out flood-control ponds and then use the excavated soil to raise up roads and houses," Harvey says. "Every village is like a little island." Villagers also use the ponds for other purposes; some bathe in them, others raise fish, and many families use them for sewage disposal. The water cycle reverses from December through May: Very little rain falls, so farmers run irrigation pumps, drawing up groundwater for their rice fields.

When Harvey and his colleagues started drilling wells to determine why arsenic levels were so high, they found that concentrations peaked at depths of about 30 meters — unfortunately, the same level at which many tube wells drew their drinking water. Testing groundwater at this depth, they found that it contained high levels of methane, which is released when microbes break down organic materials under oxygen-free conditions — for example, when they are buried in saturated soil.

Normally bacteria use oxygen to metabolize their food, but when it's not available they can use metals instead. The group theorized that bacteria were using iron oxide particles in the soil to break down organic material, such as human and animal wastes, in the process releasing arsenic bound up with the oxides. To test this explanation, they mixed groundwater with molasses, an easily degraded organic material, and injected it back into a well. Arsenic concentrations in the well rose for several days, then fell, supporting the scenario that microbes were breaking down the molasses by "breathing" rust, releasing arsenic as a byproduct. (This technique is also used to clean up contaminated groundwater at industrial and military sites: Engineers inject harmless organic substances like molasses, whey or vegetable oil, stimulating bacterial activity that breaks down toxic pollutants into more benign byproducts.)

But the mystery was far from solved. Harvey and his team knew how the arsenic was being generated, but they had no idea where the organic material that fed the process releasing the poison came from. To answer that question, they used radiocarbon dating to measure the age of organic material containing carbon at different depths in the aquifer. Some of it turned out to be less than 50 years old, which suggested that groundwater pumping in the dry season was drawing "young" water from the surface down into the aquifer, carrying organic carbon with it.

Here, Harvey saw, hydrology could help pinpoint the arsenic source. In 2002, he brought a team of graduate students in to connect the dots between surface and underground water by constructing a water balance — that is, a detailed account of water flowing in and out of a 6-square-mile area, both above and below ground."That's a routine process, but it hadn't been done in this area," he says. Using modeling and natural tracers, they developed a picture of a layered groundwater system: Rice-field water was in a top layer, water seeping down from flood-control ponds settled in a middle layer, and "older" water that had been there since before the area was developed was on the bottom.

When set in place, this tower will protect data-logging electronics from monsoon floods in the Munshiganj district of Bangladesh. Underground wires connect the data-loggers to soil-condition sensors. (Courtesy of Charles Harvey)

"The total supply of groundwater doesn't change too much in Bangladesh because the monsoon system returns an immense amount of water every year," Harvey explains. But, he says, development has changed discharge and recharge patterns. Historically, water had tended to move through the system horizontally. In monsoon season, the aquifer filled up from direct rainfall and seepage through the bottom and side beds of rising rivers; in dry months, the pattern reversed, with groundwater flowing back through streambeds to recharge rivers or upward to the roots of growing plants.

But now farmers were pumping groundwater up to irrigate their fields during the dry season and, by doing so, creating a downward pressure that pulled water from the surface. There was a surprise, though; not much of the water being sucked underground came straight down through the bottoms of flooded rice fields. Farmers plowed the fields in December, during the rainy season, when they were wet and mucky. The plowing broke up cracks and pores in the soil, so little water penetrated deep underground.

Actually, it seems, rice fields were filtering arsenic *out* of the system. Harvey and his students analyzed the chemistry of water in rice fields and found that it was very clean and saturated with oxygen generated by photosynthesis. Ultimately, other researchers found, arsenic washed out of the rice fields when they flooded during monsoon seasons.

Putting together all of these puzzle pieces, including chemical analyses of water from the rice fields, flood-control ponds and underground reservoirs, Harvey and his students concluded that water from the man-made ponds was seeping into the ground, carrying organic carbon with it. Once the organic material was deep underground, bacteria broke it down, using iron oxide and releasing arsenic.

For many reasons — the area's complex hydrology, limited funding and the logistics of doing field research in a developing country — finding and fitting these pieces together took seven years. Over the course of the project, Harvey and his students studied water in some 50 irrigation wells, 40 to 50 drinking water wells and 80 monitoring wells. The team constructed vacuum chambers to suck water into impermeable bags that were transported thousands of miles to MIT for analysis. The group published its findings that the flood-control ponds were the key link in the chain that led to elevated arsenic levels in 2009.

Scott Fendorf, a professor of soil chemistry at Stanford, has studied arsenic poisoning in Cambodia, which has a geological history much like Bangladesh's but has not been developed as intensively in recent years. "Charlie's work and ours have been nice complements," Fendorf says. "His findings show us what's happening in a place that humans have modified, and we can play off of them." Specifically, he says, Harvey's work shows that flood-control ponds are causing the problem, not rice cultivation. That's a critical distinction for countries, including Cambodia, that are less developed than Bangladesh but may follow a similar path.

M.King Hubbert, a geophysicist who died in 1989, is best known for correctly predicting in 1956 that U.S. domestic oil production would peak within 10 to 15 years. (It happened in 1970.) But he also wrote many books and articles on groundwater and structural geology issues. In 2008, the National Ground Water Association presented Charlie Harvey with its M. King Hubbert Award, which recognizes major scientific and engineering contributions to the field of groundwater hydrology.

"Charlie's work in Bangladesh is high-quality applied research that has given us fundamental new knowledge about groundwater arsenic transport. It also points toward science-based solutions to a major public health problem," says UC Davis' Graham Fogg, who nominated Harvey for the award. "You don't find many young scientists who have such a strong scientific foundation and also care about wider social relevance."

As Harvey sees it, arsenic contamination in Bangladesh is an example of a larger problem occurring in many places around the world: Land-use changes over the past 50 years have had delayed impacts – underground. Harvey's findings in Bangladesh, therefore, may help mitigate arsenic poisoning in other countries. "Everything we do in the water sector rests on our understanding of how physical systems work," says Winston Yu, who earned his Ph.D. in Harvey's lab and is now a water resource specialist with the World Bank. "In Bangladesh, we found that the prerequisites for mobilizing arsenic were a very hydraulically dynamic environment, a monsoon climate and a society that was extracting huge amounts of water and cycling it through the system at an intense rate.

"Those findings have applications to all sorts of other delta environments, like Cambodia, West Bengal and potentially Nepal."

Early this year, Bangladesh's finance minister, Abul Maal Abdul Muhith, promised that his government would make the nation arsenic free by 2013. That's a worthwhile target, but one unlikely to be hit: According to UNICEF, about 20 million people in Bangladesh use well water that contains more than the national limit of 0.05 micrograms of arsenic per liter. But Harvey's research offers some starting points for a program that would reduce the number of people drinking arsenic-laced well water. First, he says, villagers shouldn't dig more flood-control ponds. And they shouldn't drill new wells downstream from existing ponds or other water bodies where carbon-rich soils are saturated with water for long time periods — for example, stagnant slow-moving rivers.

In the United States, where arsenic hot spots are scattered mainly around the West and Southwest, homeowners can buy water filters, starting at around $150. But filtration is much too expensive for most Bangladeshis. "Median income in the U.S. is $50,000. In Bangladesh it's $600. It's a totally different context," says Shafiqul Islam, who now teaches at Tufts University.

Harvey is planning a new project in concert with environmental scientists and physicians; it will drill some deep wells into older aquifers and monitor whether they draw contaminated water from shallower depths. But deep wells aren't a perfect solution: They're much more expensive than shallow wells, and village families

like to have their own wells instead of pooling money to drill a deeper one. Moreover, according to the World Bank's Yu, Bangladeshi government agencies are very hesitant to allow drilling into deep aquifers, fearing it could make the arsenic problem worse. Harvey would also like to try installing some shallow drinking water wells in rice fields, building on his finding that rice-field water at Mushinganj was surprisingly clean and arsenic-free, but shallow wells may not produce enough pressure to pump water to the surface.

To come anywhere close to its 2013 arsenic-free target, Bangladesh's government will have to organize widespread water-testing programs and public education campaigns that persuade villagers to shift away from tainted tube wells. It will have to convince international aid agencies that the political will exists to drill new wells, run pipes or make other upgrades to connect citizens to safe water supplies, and then community leaders and social workers will have to persuade Bangladeshis to trust those new sources. It's a complex undertaking to deliver what should be one of life's simplest things — a drink of clean water — but thanks to Harvey, it will be based on a clear assessment of the depth of the problem.

http://www.miller-mccune.com/science/charles-harvey-water-detective-20153/

Putting Climate Researchers Under the Microscope

Scientists who argue for human-caused climate change published twice as many papers and are cited 64 percent more often than researchers who doubt climate change.

By Matt Palmquist

A team of Stanford University scientists have analyzed the papers published and cited by more than 900 climate researchers. (dra_schwartz/istockphoto)

In a first-of-its-kind study, a team of Stanford University scientists have analyzed the papers published and cited by more than 900 climate researchers. Using the same metrics universities employ for making hiring or tenure decisions, the paper published in the *Proceedings of the National Academy of Sciences* found that researchers who doubt climate change have less expertise and are far less prominent than their colleagues: Scientists who argue for human-caused climate change published twice as many papers and were cited about 64 percent more often than the unconvinced.

Still … the researchers aren't expecting their findings will exactly, um, convince anyone.

"I think the most typical criticism of a paper like this — not necessarily in academic discourse, but in the broader context — is going to be that we haven't addressed if these sorts of differences could be due to some sort of clique or, at the extreme, a conspiracy of the researchers who are convinced of climate change," said lead author William Anderegg, choosing his words carefully because he was still clad in his Masonic robes. "If you were a young researcher and had the data to overturn any of the mainstream paradigms, or what the (Intergovernmental Panel on Climate Change) has done, you would become absolutely famous. Everyone wants to be the next Darwin, everyone wants to be the next Einstein."

Not everyone, Anderegg. Some just want to be the next Ann Coulter.

Looking for a little light reading?
Try "Nuns, Dykes, Drugs and Gendered Bodies: An Autoethnography of a Lesbian Feminist's Journey Through 'Good Time' Sociology" by the University of Liverpool's Elizabeth Ettorre in the June issue of *Sexualities*. Admit it: You didn't even know there was such a thing as "good time" sociology, did you?

http://www.miller-mccune.com/science/putting-climate-researchers-under-the-microscope-20261/

Forensics in Three Dimensions

For the first time, a tool allows researchers to identify the ancestry of the remains of children, which may help solve some forensic cold cases.

By Megan Scudellari

Grad student Sarah Cunningham analyzes the shape of a skull in a lab. (Courtesy of North Carolina State University)

On a clear, cool Monday morning in the fall of 1998, a worker mowing beneath a highway billboard in Orange County, N.C., spotted a pair of white sneakers. Hesitating, he moved closer. Then he saw the bones.

It didn't take long for detectives to swarm the area, cordoning off the badly decomposed body. What they had found upset them all: The remains belonged to a child. An autopsy concluded the remains were from a boy between 10 and 12 years old, but there were no reports of a missing child of that age in the area.

Twelve years later, the police still hadn't identified the boy, so Tim Horne, the detective in charge of the cold case and a father himself, approached anthropologist Ann Ross at North Carolina State University to see if there were any new methods to help identify him. Ross agreed and suggested they try an unorthodox approach — determining the child's ancestry.

Anthropologists study the ancestral origins of skeletons to track the movement and relationships among populations of people. Forensics experts use ancestry to help classify unidentified remains. Yet both groups typically refrain from analyzing the ancestry of the remains of children. And for a good reason — there has been no good way to do so.

Calipers, the Swiss Army knife of forensics, are a simple measurement device used since the time of the Greeks and Romans. They are great for measuring linear distances on a skeleton, but are not good for comparing adult skulls to children skulls: The size differences between small children's skulls and full-grown adult skulls are non-comparable. Researchers typically do not try to identify the ancestry of child skeletons since they can't compare them to adult skeletons.

Until now.

In 2005, Ross teamed up with Dennis Slice, a professor of scientific computing at Florida State University, on a grant from the National Institute of Justice to develop a way for anthropologists and medical examiners to use "geometric morphometics" to determine the sex and ancestry of unidentified remains.

Geometric morphometrics is the three-dimensional analysis of the shape of a surface. Using this mathematical technique, size can be removed from the equation, focusing instead on shape. Ross recently published results using the technique on 24 skulls at the University of Pennsylvania Museum of Archaeology and Anthropology. She demonstrated — for the first time — that there are no significant shape differences between teen and young adult crania, suggesting that the adult shape of a face is attained years earlier than researchers previously thought. This new mathematical technique, therefore, can identify the ancestry of younger skulls.

In January, Ross and Slice debuted 3D-ID, a simple Java program that allows anyone with a computer and a digitizer to determine the ancestry of a skull. It is freely available at 3D-ID.org. "All you have to do it collect the data, plug it in, and it spits an answer out at you," Ross says.

The program is designed to be widely applicable for medical examiners and anthropologists alike who may not be familiar with the complicated math of geometric morphometrics. "It's just a matter of getting people used to using a digitizer" rather than calipers alone, Ross says.

In Ross' lab at North Carolina State, Sarah Cunningham, a graduate student in anthropology, demonstrates the program. Leaning over the cast of a skull held in place with clay on a metal stand, Cunningham places the slim metal tip of a digitizer — a pen-like device that records x, y and z coordinates in space — to the bridge of the nose.

"You have to make sure you get the right point," says Cunningham, craning her neck to reach another spot at the back of the skull.

Once Cunningham has entered 32 data points, 3D-ID will compare the information with a reference population of more than 1,000 individuals from various ancestries that Ross and other researchers have collected over time from museums, medical schools and even study collections dug up from old cemeteries. "As the reference population gets bigger, we're getting better," Ross says.

In addition to applications in forensics, 3D-ID will expand the ability of anthropologists to study past civilizations: They can now use the remains of children to determine what a population looked like in a specific area, instead of relying solely on adult remains.

The technique may also have clinical applications, Ross says. There is currently a lack of population-specific standards for reconstructive surgery in children, she says, and using 3D-ID data, clinicians should be able to develop standards for reconstructing a child's facial structure based on his or her ancestry.

When Horne invited Ross to try the technique on the remains of the John Doe boy, it was by far the youngest child she had ever attempted to classify. Using geometric morphometics, Ross determined that the boy was of Mesoamerican descent, a region extending from the middle of Mexico into Central America.

Knowledge of his ancestry has led the police to believe the child was perhaps an illegal immigrant, which was maybe why they have uncovered so little information on his disappearance over the last decade.

"I was thrilled, to say the least," Ross said. "They've been working on this for a long time." With that knowledge in hand, the search for the boy's identity continues.

http://www.miller-mccune.com/science/forensics-in-three-dimensions-20064/

Listening for the Key to Reverse Aging

New research on responding to sound may have found a key to reversing, or even preventing, one of the effects of aging.

By Jessica Hilo

(Ernest Figueras/Flickr.com)

"I feel weak today. I felt much stronger yesterday — like Benjamin Button in reverse," remarked a breathless Michael Scott, managerial dimwit from NBC's *The Office*. This is one of a few recent nods the show has made to academy-award nominated film, *The Curious Case of Benjamin Button*; the latest, seen this season, shows Dwight and Angela discussing provisions of a baby contract, with one clause outlining what to do if their child is born an old man.

What prompts Button's water-cooler popularity, and much to the chagrin of its tagline writer ("Life isn't measure in minutes, but in moments"), is our insatiable desire to track — and counter — the effects of aging. So voracious is this appetite that we happily endure long Botox waiting lists and gobble up seemingly innocuous age-research in hopes of staving off the effects of aging.

Enter our furry-eared lead story, birthed from the W.M. Keck Center for Integrative Neuroscience at the University of California, San Francisco. Here, researchers have tested the link between sensory deterioration and neurophysiological decline in aging lab rats — or, in Michael Scott terms, how the shutting down of sensory organs with age affects the brain.

In a healthy brain, sound is received when it is processed by the auditory cortex; an area of receptors located in the temporal lobe. Damage to this area — as in the case of a stroke, a tumor, or old age — leads to a loss of sound awareness. Despite this damage, the brain still maintains the ability to react to an audio pitch, especially to sounds of a particular frequency or repetition.

In a recent study, UCSF researchers found that trained lab rats were able to recover more than 20 auditory cortex alterations. In most cases, they saw a partial or complete reversal of auditory damage. This study

provides compelling evidence that the effects of aging — at least in the auditory cortex of elderly lab rats — are both reversible and preventable.

The study
Researchers trained five young and five aging lab rats for an hour a day over one month. Training was designed to improve frequency reaction and sound processing. The rats were rewarded for identifying a deviant tone played amid a line of standard tones. Difficulty was increased by reducing the frequency differences between standard and "oddball" tones.

"Despite their generally poorer performance," wrote researcher Michael Merzenich, "aged rats learned task rules as rapidly as did young ones."

Scientists then assessed the impact of auditory training by running the group against a set of young and aged untrained control rats. All the rodents were subjected to a repetitious sequence of standard and oddball tones and tested for reaction and identification of sound. Scientists were surprised to note improvements in the aged-trained group in ability to discriminate frequencies previously unheard and still undetected by their aged untrained counterparts.

Alongside improvements in audio discrimination, researchers observed an increase of protein expression in the auditory cortex. The increased proteins (cortical parvalbumin and myelin basic) play a crucial role in brain recovery and, scientists posit, serve as the reason older, trained rats had shown such improvement. These findings suggest that the decline observed in the auditory cortex from age is not only preventable, but, with training, reversible.

From rats to humans
The study carries hefty implication for the use of audio in neurorehabilitation therapy for humans, especially in cases of age-related dementia, Alzheimer's and sensory degradation.

In some cases of dementia, music is already being used to ameliorate symptoms of agitation, anxiety and depression. In instances of age-related decline or injury therapy, music and rhythmic cues are being used for cognitive rehabilitation, spatial awareness and muscle recovery. Findings from UCSF may help therapists hone training strategies and tailor their use of audio to not only treat symptoms of age-related decline, but improve the degradation of its causes.

The hope in scientific approaches to reversing the effects of age sounds eerily like that quest for the fountain of youth. And, for now, we can only claim the impact of such approaches as beneficial to our beloved aging lab rats. So, whether we're faced with the interminable workday, or the obnoxious tick of an unending clock, in life's long measurement, sometimes it doesn't hurt to savor the moment.

http://www.miller-mccune.com/health/listening-for-the-key-to-reverse-aging-21283/

Palliative Care May Trump Heroic Measures in Life Expectancy

A new study finds palliative care doesn't put patients out of their misery; it puts the misery out of the patients.

By Joanne Kenen

A study finds that palliative care, which includes talking to patients and families about treatment goals and end of life wishes, doesn't hasten death. (SimpleFoto/istockphoto)

What if those "death panels" were actually good for your health?

The death panels, of course, don't exist; they were the product of overheated political imaginations amid an overheated debate about health care reform. But palliative care does exist — and despite the distortions of last summer's debate, it doesn't mean "pulling the plug on Grandma." (Or Grandpa for that matter, although he seems to have been neglected in the national brouhaha about death panels.)

A study published this week in the *New England Journal of Medicine* found that palliative care — which includes talking to patients and families about treatment goals and end-of-life wishes — doesn't hasten death.

To the contrary, the study of terminally ill lung cancer patients found that early access to palliative care prolonged life — even though the patients opted for less aggressive care as they neared death.

Researchers compared two similar sets of patients at Massachusetts General Hospital with advanced metastatic non-small cell lung cancer — the lethal and fast-moving form of the disease. Both groups got

standard cancer treatment, consisting of chemotherapy and/or radiation. But one group also got early and ongoing palliative care.

By several standard measures, the palliative care group had a better quality of life at 12 weeks and was less depressed. In other words, palliative care didn't put the patients out of their misery. It took at least some of the misery out of the patients.

"Among patients with metastatic non-small-cell lung cancer, early palliative care led to significant improvement in both quality of life and mood," the authors wrote. "As compared with patients receiving standard care, patients receiving early palliative care had less aggressive care at the end of life but longer survival." More chemotherapy didn't mean more life.

Patients in the palliative care group lived 11.6 months, compared to 8.9 months for the standard group. Two to three months is a long time for a patient with advanced lung cancer. Two months is about how long the state-of-the-art chemotherapy drugs extend life. And some of the chemo drugs carry risks that themselves can shorten lives.

The study was not designed to directly measure or compare costs, although it did look at utilization of health care. Patients who received ongoing palliative care spent less time in the hospital, made fewer trips to the emergency room and were less likely to have chemotherapy in the last two weeks of life. They were more likely to have their end-of-life wishes clearly documented in their medical records, and their median stay in hospice was 11 days, compared to four days for the nonpalliative group.

The researchers say that more analysis is needed to confirm that less intensive care was less expensive.

This research, funded in part by an American Society of Clinical Oncology Career Development Award, and with collaboration from researchers at Yale, Columbia and the State University of New York at Buffalo, has limitations. Mass General is a resource-rich setting with a well-known, well-developed palliative care program available to inpatients and outpatients. Most of the patients in the study were white. And it deals with only one disease, a particularly dire lung cancer. More outcome, quality and economic research will be needed to analyze the benefits of early palliative care on other cancers as well as other diseases.

Still, palliative care leaders expect the findings to resonate.

For most of the last 20 or 30 years, hospice has been the main focus of end-of-life care, providing both management of pain, nausea, delirium, shortness of breath and other distressing symptoms while also providing psychosocial and spiritual support for patients and families, usually at their home.

But hospice generally requires people to give up curative — what doctors call "disease-modifying" — care, which may mean hurtling off an emotional cliff as this implies accepting the imminence of death. Hospice is available to patients expected to live six months or less, which may or may not be easy to predict, depending on the disease, and the individual. So people often put off seeking hospice care until they are quite close to death — or they never seek it at all, increasing the odds of dying in the hospital, quite possibly hooked up to invasive machines in an ICU.

Palliative care has grown over the last decade or so in an attempt to give people a similar multipronged approach to serious illness — without having to give up curative treatment or be on the brink of death. But it

is not always available, and often misunderstood. Practitioners hope this study helps them clear up the myths and establish the benefits, enabling them to make the case for offering it to more patients earlier in the course of their disease.

Jennifer Temel, an oncologist at Massachusetts General and the lead author of the study, said fellow cancer doctors often regard palliative care as a last-resort discipline, a place to turn to when cancer treatment fails — not as a companion treatment.

"Patients can get expert cancer care and comprehensive palliative care at the same time," she said in an interview summing up the study's message. "And it has an impact on their symptoms and life expectancy."

Palliative care teams offer more than a jolt of morphine at the death bed (although morphine and its pharmacological cousins are part of the palliative tool kit). It includes management of symptoms, guidance in decision-making and psychosocial support for both patients and families.

The new federal health reform law expands palliative care coverage for seriously ill children on Medicaid or the State Children's Health Insurance Program (better known during Washington wrangling by its acronym, SCHIP). It also creates a three-year, 15-site program to test a "concurrent care model" that allows terminally ill patients to access hospice without having to surrender other treatment.

"It's about matching treatment to patient goals," said Diane Meier, who directs the Center to Advance Palliative Care based at New York's Mount Sinai School of Medicine, which has helped train palliative care teams and helped them make the case to hospitals as to why it's both good medicine and good business.

"It's not about denying beneficial care," added Meier, who co-authored an editorial that accompanied the *New England Journal of Medicine* study. "It's about providing beneficial care in the safest, most appropriate setting."

The study began with 151 patients; 27 of whom died within 12 weeks. One hundred and seven completed assessments. Additional data was collected from the patient's electronic medical records. Palliative care patients had their first appointment within three weeks of enrollment, and at least one a month thereafter. Patients in the control group who requested a palliative care consult could also get it, and some did, but that didn't dilute the study's bottom line.

The palliative care patients were less depressed — even though the standard care patients were as likely to be taking antidepressants. It's not that the pills don't help the "standard" patients, said Vicki Jackson, a Mass General palliative care physician who collaborated with Temel. It's that the palliative approach added a whole other component by addressing the person, not just the illness — the physical symptoms, the psychological stresses, the decision-making, the needs of the family.

"You are addressing what matters to them, the context of the disease," agreed Ira Byock, a longtime leader in hospice and palliative medicine now at Dartmouth-Hitchcock Medical Center who was not involved in this study. "When someone has a life-threatening illness — involving their emotional, social, spiritual well-being — their personal life is inseparable from their physical health."

"This is an incredibly important study," he added. "It demonstrates the efficacy of palliative care in both improving quality of life and extending length of life."

Jackson said palliative care can give patients a “safe space” to confront their condition and evaluate choices. “These patients are very sick and they are complicated. They are more likely to tell the palliative care doctor when they are feeling poorly than the physician holding the keys to the chemo cabinet.”

“We help educate them as to what’s possible — that it’s fine to ask the oncologist to postpone chemo for a week to go to the beach with the family. We found patients are more likely to talk to me about what it would mean if they stopped treatment. It doesn’t mean they don’t have a good relationship with Jennifer [the oncologist]. But they didn’t want to let Jennifer down. There’s a different relationship.”

To doctors in the trenches — or at least in the ICUs — the study resonates. “These conversations are hard. It’s not easy for the oncologist to change from cheerleader to, ‘This isn’t going the way you want it to go,’” said Christopher Hughes, critical care specialist at St. Clair Hospital in Pittsburgh, who has seen oncologists keep offering chemo rather than “deal with what’s at hand.”

When Hughes encourages goal-setting and end-of-life conversations, he said, he has found patients don’t really want “chemo while they are nailing your coffin. … Most people will choose a shorter, higher quality life.” But even before the empirical evidence of this study, his own observations had taught him, “It’s not always going to be shorter.”

http://www.miller-mccune.com/health/hospice-may-trump-heroic-measures-in-life-expectancy-21098/

What We Miss When We Obsess Over Obesity

Social epidemiologist Paula Lantz reveals what actually leads to premature deaths among Americans. Obesity? No. Poverty? Yes.

By Tom Jacobs

(Illustration by Wesley Bedrosian)

Just as Congress was concluding a contentious year of debate by passing legislation to overhaul the health care system, a revealing look at lifestyle, income and mortality was published in the journal *Social Science & Medicine*. It followed a cross-section of American adults to determine precisely which factors drive us to an early death.

Some of the answers were expected. Cigarette smoking. A sedentary lifestyle. Being poor.

One well-publicized issue did not make the list: Obesity. For all the breathless media coverage of our collective weight gain over the past few decades, it turns out that unless one is morbidly obese, those extra pounds are not a significant risk factor for premature death.

This does not mean the lead author of the aforementioned study, Paula Lantz, is proposing we all relax and pig out. The University of Michigan social epidemiologist fully recognizes obesity as a national health problem. But her research suggests our current focus on weight is a bit (ahem) narrow and at least somewhat misleading.

In the popular imagination, lack of exercise and obesity tend to be lumped together as a health problem, as do low income and low education levels. But Lantz has managed to isolate these factors, and in doing so she has brought welcome clarity to a confusing discussion.

Yes, she argues, a sedentary lifestyle contributes to obesity, but it is also a risk factor for mortality in and of itself. Sitting and staring at the television for hour upon hour is hazardous for your health whether or not you are munching Cheetos as you change channels.

***Miller-McCune*:** Let's start by describing the data set you used for this new analysis, the Americans' Changing Lives study. It features information on about 3,600 adults — that is, people who were 25 or older when the first wave of data was collected in 1986. What makes this a good sample to study?

Paula Lantz: It was set up to follow a population of adults over time to find out what contributes to healthy aging. It's ongoing — we're looking at people at more than one point in

time — and it's national in scope. Other studies have a larger sample size, but they're not nationally representative. We've been following this population for 19 years, looking at who died, who didn't, and how this relates to patterns of people's social characteristics or behaviors. At the time we did our analysis for this paper, 30 percent of the people in the sample had died. We get [cause of death] information from death certificates.

***M-M*:** Your focus in this study was "risk factors for mortality." What exactly does that mean?

PL: Characteristics or behaviors that might be associated with an increased risk of dying earlier than you would expect otherwise. Smoking is a risk factor for mortality, as smokers will die at a younger age if everything else is equal.

***M-M*:** You concluded that, compared to people in a normal weight range, neither being overweight nor obese is significantly associated with mortality risk. In fact, those conditions were actually protective against mortality for people over age 55. Did those people surprise you?

PL: No. If you take a representative sample of the general population and follow them forward, there are not very many studies that find an increased risk of mortality due to obesity. The only exception is the morbidly obese — those with a body mass index of 35 and above. They represented 3 percent of our study, although it's a growing number in the U.S.

***M-M*:** So is our concern about obesity overblown?

PL: I do think concerns about the relationship between obesity and mortality have been a bit overblown. Unless you're controlling for a lot of other things associated with obesity, you're going to overestimate the impact of obesity. What our results suggest is a lack of physical activity is a much stronger predictor of mortality than is obesity.

***M-M*:** Why is that?

PL: There are a lot of mechanisms by which physical activity can reduce the negative effects of certain chronic conditions, especially related to heart disease and stroke. Being physically active has great benefits for your cardiovascular system. It can also reduce stress.

***M-M*:** So why are both the government and the media so focused on weight?

PL: For some good reasons. Obesity is leading to a very different public health problem: A lot of people are living for a long time with serious chronic illnesses that are caused by, or exacerbated by, obesity. We're talking diabetes, arthritis, heart disease, some kinds of cancer. These diseases reduce people's quality of life, and treating them is expensive.

***M-M*:** Traditionally, people have put on weight later in life, but in recent decades childhood obesity has become a growing problem. Are we in uncharted territory as we look ahead and ask what the health effects will be of being heavy one's entire life?

PL: We are. We have all these kids now who have been overweight their entire lives. That could definitely be a risk factor for premature mortality, but we can't speak to that now.

***M-M*:** You identify smoking as a major risk factor for premature death. So it's good news that the percentage of Americans who smoke cigarettes continues its steady decline. If smoking can become less socially acceptable, does that suggest some of the other bad health behaviors we currently engage in can also decline over time?

PL: Yes. We can take a lot of lessons from what we learned about tobacco use, prevention and control and apply them to the promotion of more healthy lifestyles. A lot of factors contributed to making the smoking rates go down. It is not a case where people got more information, understood it was bad for them and quit doing it.

Taxing cigarettes was, and is, a huge factor. Kids are more price-sensitive than adults, and in the U.S., people start smoking when they're adolescents. Preventing kids from starting to smoke [by making cigarettes prohibitively expensive] is a big part of the story.

Applying that concept to obesity, taxing sugared beverages — which has happened in a few places — could make a huge difference. It could also generate revenue for states that are struggling fiscally right now. But politically, it's a hard sell.

I've come to believe soda is really a problem. The rise of obesity among kids is highly correlated with the increase in consumption of soda and other sugared beverages. The studies suggesting that are pretty compelling. If you just drink two Cokes a day, that's a lot of extra sugar.

***M-M*:** Presumably if you get people moving more, the obesity problem will abate somewhat, since at least people will be burning more calories. Are there studies showing what we think of as intuitively true — that people are more sedentary in this day of staring at computer screens all day?

PL: I think that's very well established, and it concerns me very much. We need policy and program interventions to emphasize the importance of physical activity. I wouldn't take the focus away from obesity; both are important, and we're going to have to attack both of them.

***M-M*:** What other trends are contributing to the problem?

PL: One factor is the changes in our built environment. We're much more dependent on cars than we were even 30 years ago. Sprawling suburbs aren't really conducive to walking from place to place, and in inner cities you've got broken sidewalks, parks that haven't been kept up in some places and concerns about safety. To intervene in the obesity problem and the physical activity problem, there is going to have to be attention paid to the built environment.

Obviously, there is an element of personal responsibility in all this. But looking at this sociologically, it plays out differently in different social strata. There is a fundamental lack of basic resources in some neighborhoods. It's hard to take personal responsibility if you don't have the money to join a gym and you have no access to healthy food in your immediate neighborhood. The place where you can get the most calories for the least money is McDonald's. Their food is dirt cheap on a per-calorie basis.

***M-M*:** This brings up another interesting finding of your study, which is the strong link between mortality and socioeconomic level.

PL: It looks like education level is the main thing predicting whether people get a life-threatening illness in the first place. This is related to health behaviors. Smoking rates are a perfect example: They've gone down among all groups, but they're way down among people with a college education.

But the onset of illness and the progression of illness are two different stories. Once you're sick, income becomes much more important. The issue becomes how you manage it, which determines whether people die from the illness and if so, how soon. Access to medical care is part of the story, but it's not the entire story. Even if everyone in the country had the exact same health insurance and the exact same access to care, we would still see these disparities — as we do in countries that have national health insurance.

***M-M*:** So why is being poor hazardous to your health?

PL: Stress processes probably play a role. Chronic stress is not good for immune function. [Difficulties with] housing, transportation, income security — all those factors can produce stress. Do you have friends and family — people who can actually help you get to the doctor? Is your community organized in such a way that it provides the resources you need?

***M-M*:** Do you think the health care reform bill that recently passed will have an impact in terms of lessening the disparities in health in this country?

PL: The bill that passed is a big beast. The main thing it does is extend health insurance coverage to a greater number of Americans. That's a good thing, a necessary thing, but it's not sufficient to reduce disparities.

There is funding in the bill for more community-based prevention. That's a good start. There is recognition within the bill that health and health care are not the same thing.

***M-M*:** What factors are you looking at as this new system begins to take shape?

PL: I'm worried that the focus will be on the health insurance exchanges and expanding Medicaid, while the broader mission of public health will be subsumed. In public health, we talk about primary prevention — let's stop diseases before they occur. That's where a lot of effort needs to be made, but states will be very focused on the health insurance part of this. I want to make sure the broad mission of public health will still be in the forefront.

***M-M*:** How do physicians react when you present them with your findings?

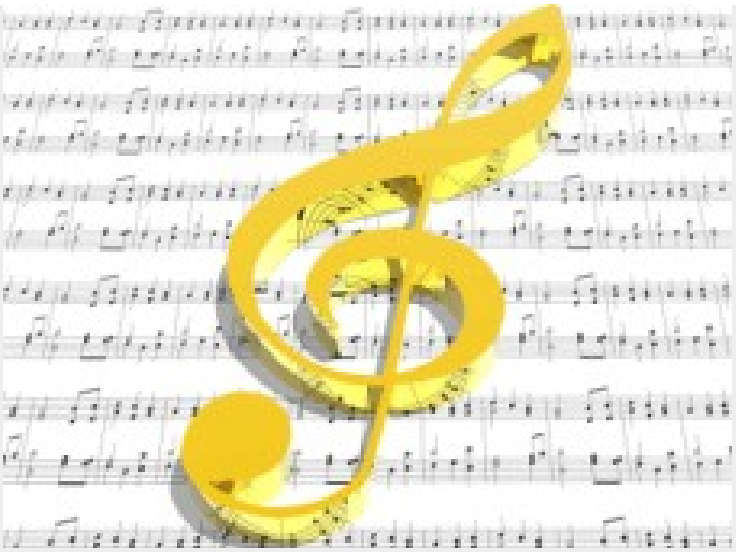
PL: They're not that surprised. A lot of physicians have said to me, "One of the messages from your paper we want to start touting is the physical activity finding — that any level of physical activity helps reduce mortality. Now I can tell my patients: Don't worry so much about the weight right now. Just get off the couch!"

http://www.miller-mccune.com/health/what-we-miss-when-we-obsess-over-obesity-20213/

Classical Music an Effective Antidepressant

New research from Mexico finds music of Bach and Mozart helps ease the pain of people suffering from depression.

By Tom Jacobs



Listening to certain classical works helps ease the debilitating symptoms of clinical depression. (Osuleo/istockphoto)

The Mozart Effect — the notion that listening to classical music will turn your infant or toddler into an intellectual titan — has been largely debunked. But a growing body of research suggests music can play an important role in certain aspects of health care, including pain management.

A newly published study from Mexico reports repeated listening to certain classical works — including one by Mozart — helps ease the debilitating symptoms of clinical depression.

"Music offers a simple and elegant way to treat anhedonia, the loss of pleasures in daily activities," the research team, led by Miguel-Angel Mayoral-Chavez of the University of Oaxaca, reports in the journal *The Arts in Psychotherapy*.

Following up on a small number of recent studies, the Mexican team conducted an experiment on 79 patients of an Oaxaca clinic. The 14 men and 65 women, ranging in age from 25 to 60, were diagnosed as suffering from low to medium levels of depression. They were not taking any medications for their condition.

All participated in an eight-week program. Half the group took part in a 30-minute weekly counseling session with a psychologist; the other half listened to a 50-minute program of classical music each day. Their

recorded concert featured two baroque works (Bach's *Italian Concerto* and a *Concerto Grosso* by his contemporary, Archangelo Corelli) and Mozart's *Sonata for Two Pianos.* Each week, participants reported their levels of depression-related symptoms using a standard scale.

"We found positive changes at the fourth session in the music therapy group, with the participants showing improvement in their symptoms," the researchers report. "Between the seventh and eighth weekly sessions, we observed improvement in 29 participants, with a lack of improvement in four. Eight abandoned the group."

In contrast, among those who had experienced talk therapy, only 12 subjects showed improvement by Week Eight, compared to 16 who showed no improvement. Ten abandoned the study.

"Our results show a statistically significant effect for music," the researchers conclude. "(They) strongly suggest that some baroque music, and the music of Mozart, can have conclusive beneficial effects on depressed patients."

The researchers point to several possible reasons for the participants' improved mental states, including the fact music "can activate several processes which facilitate brain development and/or plasticity." They note that depression is often associated with low levels of dopamine in the brain, and/or a low number of dopamine receptors. Previous research has found listening to music can increase dopamine levels.

Given the overhyping of the Mozart Effect, it's important to note these results do not mean (a) that talk therapy is unimportant, or (b) that people should throw out their Prozac and put on some Prokofiev. But as Mayoral-Chavez puts it, they do suggest people suffering from low- and medium-grade depression "can use music to enhance the effects of psychological support."

The researchers aren't claiming that Mozart's music is uniquely magical; they note that different types of music "may have different effects on different people." But the music they chose — complex, upbeat, stimulating — was clearly effective. And the patients even enjoyed it … after a while.

"At the beginning of the study, many of the chosen patients did not show a good disposition to listen to the music," they report. "But later on, they not only proved to be interested parties, but also asked for more music of this type."

http://www.miller-mccune.com/health/classical-music-an-effective-antidepressant-20226/

No More Dozing Off in First Period

An 8:30 a.m. high school start time helps students get more sleep, stay alert in class, a pilot study finds.

By Melinda Burns

Doctors recommend that adolescents get nine hours of sleep on school nights for optimal performance. (Build Creative Group/istockphoto)

A pilot study at a small private high school in Providence, R.I., has confirmed the well-documented benefits of a half-hour delay in the school start time for teens, an easy fix for the chronic and rampantly ignored sleepiness of adolescents.

The study shows that two months after the St. George's School changed its start time from 8 to 8:30 a.m., students were getting 45 minutes more sleep on school nights, on average, or nearly eight hours in all. They were going to bed an average 18 minutes earlier, presumably because it felt so good. On Sundays, they spent less time sleeping to catch up.

"Well, for me," one student said, "ever since the 8:30 start I have seen how much good 30 minutes of extra sleep does for me, so I have been inspired to … get an additional half hour on top of the 30 minutes."

Teens are among the Americans least likely to get enough sleep, according to the National Sleep Foundation, a Washington, D.C.-based nonprofit group and proponent of later start times. Doctors recommend that adolescents get nine hours of sleep on school nights for optimal performance, but the research shows that they

average less than seven. According to a recent foundation poll, 80 percent of U.S. teens are not getting nine hours of sleep.

"It's not surprising that a large number of studies have now documented that the average adolescent is chronically sleep-deprived and pathologically sleepy," said Judith Owens, a sleep expert at Rhode Island's Hasbro Children's Hospital and the lead researcher on the St. George's study. The consequences, she said, can range from mood, attention and memory problems to obesity and low grades.

"We're really fighting biology," Owens added. "It's time we started to recognize that sleep is not an optional activity. Adolescents cannot fall asleep much before 11 at night. If they have to start school at 8 a.m., they're not going to get anywhere near the hours of sleep they need."

A number of studies in the past decade have compared high schools and middle schools with different starting times, finding that even a half-hour later start can improve student dropout and attendance rates and help students concentrate. In one study, there was even a drop in the number of crashes due to drowsiness while driving.

The study at St. George's is the first to compare the same students at the same school. More than 200 students, grades nine through 12, filled out online surveys before and two months after the start time shifted to 8:30 a.m. After the change, they reported feeling less depressed and irritated and more motivated to do homework and play sports.

Significantly, fatigue-related visits to the school's health center dropped by two-thirds during the trial period, and the number of students who overslept and were late to first period or missed it completely dropped by nearly half. Students' grades — high to begin with — did not go up, Owens said. (Other studies have seen some correlation between more sleep and better grades.)

The school day at St. George's was not extended. Instead, five to 10 minutes were cut from classes, assemblies and afternoon activities to make up the difference. At the end of the pilot study, the students and faculty voted overwhelmingly to retain the 8:30 a.m. start time.

"Even modest changes can have a big impact," Owens said, adding that her routine improved, too. Her 17-year-old daughter, who attends St. George's, began waking up in a better mood.

"Our mornings are a whole lot nicer," Owens said.

The concept has not caught on beyond a few scattered districts, primarily in Minnesota, Massachusetts and Kentucky. Parents may object to a later start time in high school because they want their teenage children to take care of younger siblings after school. Teachers like getting home earlier, too. And coaches complain that a later start would make it difficult to stay in sync with games at other schools.

The problems are magnified for high schools that start at 7 a.m. or 7:30 a.m.: They would have to shift their start times by an hour or more to reap the benefits, Owens said. Somewhere along the line, for whatever reason, she said, high schools in America began opening earlier in the morning than elementary schools. Now, it's an entrenched practice and a serious public health problem.

No one functions well on inadequate sleep, Owens said: "Adults can't handle it either."

Research shows that teens produce the brain hormone melatonin later at night than children and adults do, prompting a reset of the circadian rhythm, an internal biological clock. They fall asleep up to two hours later than when they were younger.

"On a practical level, this means that the average adolescent has difficulty falling asleep before 11 p.m., so the ideal wake time is around 8 a.m.," Owens said, adding that homework, extracurricular activities and after-school jobs can make it even harder for teens to get the sleep they need.

Although the St. George's study showed marked sleep improvement with a delayed school start time, it fell short of achieving the ideal. Only 11 percent of students reported getting the recommended 9 hours of sleep. Two-thirds said they still felt sleepy doing homework, 18 percent reported falling asleep in a morning class and 36 percent reported napping sometime during the week.

"Probably, 9 o'clock would be the ideal start time for high schools," Owens said.

http://www.miller-mccune.com/health/no-more-dozing-off-in-first-period-19579/

How Not to Stop Smoking

New research finds suppressing thoughts of smoking just increases the likelihood you'll light up later on.

By Tom Jacobs

Researchers provide evidence that thought suppression can sabotage attempts to quit smoking. (Raul Lieberwirth/Flickr)

Over the past 25 years, a series of studies have found suppressing unwanted thoughts is not only ineffective, but counterproductive. Try to not think of a white bear, and chances are the creature will come roaring into your mind.

In 2007, British psychologist James Erskine applied this dynamic to diet. He reported women instructed not to think about chocolate consumed more of the high-calorie treat when offered it, and suggested this rebound effect may explain the failure of so many dieters to lose weight over the long term.

Now, in a paper just published in the journal *Psychological Science*, he and two colleagues provides evidence that thought suppression can also sabotage attempts to quit smoking.

Their study featured 85 regular cigarette smokers (42 men and 43 women). While 70 percent of them had attempted to quit smoking at some point, none were actively attempting to do so at the time of the experiment.

Each day for three weeks, participants recorded the number of cigarettes they smoked that day, as well as their stress level. One week into the experiment, one-third of the smokers were asked to "try not to think about smoking. If you do happen to have thoughts about smoking this week, please try to suppress them." Another third were instructed to think about smoking as frequently as possible during the week. The final third received neither instruction.

During that second week, "the suppression group smoked considerably less than both the expression group (those encouraged to think about smoking) and the control group," the researchers reported. But the situation reversed itself in Week Three, as those in the suppressed-thoughts group smoked considerably more than those in the other two categories.

"This suggests that in the short term, suppression may be effective in reducing unwanted behavior," Erskine and his colleagues write. "This may explain a troublesome aspect of thought suppression — that individuals perceive the strategy as beneficial."

Which it is — but only until the rebound hits.

Those in the suppression group reported higher stress levels in Week Two than those in the other two groups, but the researchers found this effect was not responsible for the increase in Week Three smoking. Rather, the results appear to reflect a pure bounce-back effect: The white bear returns, carrying a carton of Pall Malls.

In the researchers' view, these results "suggest that thought suppression may be more harmful than previously believed," especially for struggling addicts. So if you're craving a cigarette, let the image of that glowing cylinder linger in your mind until it fades away on its own. Pushing it aside only makes it more likely you'll light up later.

http://www.miller-mccune.com/health/how-not-to-stop-smoking-19937/

The Magnetic Appeal of a Meaningful Life

A sense one's life has meaning increases one's allure in social situations, according to new research.

By Tom Jacobs

New research suggests that attractiveness in social situations is increased if someone senses that another person has meaning in their lives. (Stacey Newman / istockphoto.com)

Why are we drawn to one person and not another? Physical attractiveness is one obvious ingredient, but researchers have identified another, quite different factor that heightens one's personal appeal.

It seems we enjoy socializing with people who have found meaning in their lives.

"Meaning is a powerful and independent predictor of interpersonal appeal," reports a study titled "Meaning as Magnetic Force," just published in the journal *Social Psychological and Personality Science.* "People seek interpersonal connections with those who have found meaning in life."

The idea that the search for meaning in life is a basic human drive was famously articulated by psychologist Viktor Frankl in 1946, not long after he was liberated from a Nazi concentration camp. According to team behind this new research, "a natural extension" of this idea "is that people will seek to affiliate with those who have a strong sense of meaning."

In other words, people searching for a purpose in life — whether or not they are consciously aware of this deep-seated desire — will likely be attracted to others who have arrived at an answer.

The researchers, led by psychologist Tyler Stillman of Southern Utah University and including Roy Baumeister of Florida State University, tested this thesis in two experiments.

In the first of these, 70 undergraduates answered a series of questions to gauge two variables: Their level of self-esteem and the extent to which they perceived their lives were meaningful. They were then videotaped as they interacted with a friend.

Five trained raters subsequently watched the tapes and answered the question, “How much would you like to be friends with this person?”

“A stronger sense of meaning in life was associated with interpersonal appeal,” the researchers report, “whereas self-esteem had no effect.”

For the second study, 72 undergraduates completed a more wide-ranging questionnaire, designed to measure their levels of happiness, extraversion and religiosity, as well as their sense of personal meaning. Each then videotaped a 10-second introduction, presenting themselves as they would to someone they had just met at a social gathering.

Eleven trained raters evaluated the study participants by answering three questions: How likable is this person? How much would you like to be friends with this person? How much would you enjoy a conversation with this person?

Those who reported a greater sense of meaning in their lives were rated higher than their peers on each of those scales.

“One alternative explanation is that people simply want to affiliate with well-adjusted people,” the researchers write. However, their finding that personal appeal was unrelated to happiness or religiosity makes that unlikely. They add that “[m]eaning in life even predicted interpersonal appeal over and above a potent predictor of positive impression formation: extraversion.”

Stillman and his colleagues did find physical attractiveness is a strong source of personal appeal. “Yet for participants who were of average or below-average attractiveness,” they note, “having a strong sense of meaning made them significantly more appealing social interactants.”

So if you’re looking for a mate, or a wider circle of friends, one counterintuitive but effective strategy may be to look within, determine what it is that gives your life meaning and then act on that impulse. Sure, there’s something about Mary — she was, after all, played by Cameron Diaz — but there’s also something about people with a purpose.

http://www.miller-mccune.com/culture/the-magnetic-appeal-of-a-meaningful-life-21236

Married Couples Don't Grow More Alike Over Time

New research finds scant evidence for the notion that, in terms of personality, couples grow more similar to one another over time.

By Tom Jacobs

Research suggests spousal similarity is more a matter of initial choice than gradual convergence. (Ian MacKenzie/Flickr.com)

In spite of the cliché that opposites attract, considerable research suggests couples — at least those who make long-term commitments — tend to have similar personalities. But are they attracted to one another because of their shared attitudes and beliefs, or do they grow to resemble one another over time?

Research just published in the journal *Personality and Individual Differences* points to the former conclusion. It suggests spousal similarity is more a matter of initial choice than gradual convergence — with the apparent exception of one personality trait.

A team led by Michigan State University psychologist Mikhila Humbad looked at 1,269 couples, who had been married for an average of just under 20 years. (The data was compiled by the Minnesota Center for Twin and Family Research.) Analyzing responses to a detailed Multidimensional Personality Questionnaire, the researchers examined whether the differences between husbands and wives narrowed depending upon the length of their marriage.

They found only “sporadic” evidence backing up that thesis, much of which “would be expected by chance alone.” They conclude the evidence argues against gradual convergence of personality as a compelling explanation for spousal similarity.

But they found spouses may influence one another in one important area.

“Aggression may be an exception to this general conclusion,” they write, “as the correlation between the difference score and marriage length was significant, and there was some indication a longer marriage length predicted a smaller difference score.”

Why might this be? “It is possible that individuals might reinforce each other’s aggressive tendencies due to hostile interpersonal exchanges, thereby promoting greater convergence over time,” they note.

So hostility on the part of one spouse can gradually bring out the hostility in another. Isn’t there a Stephen Sondheim song about that?

http://www.miller-mccune.com/culture/married-couples-dont-grow-more-alike-over-time-20849

Forgiveness, Resentment and Blood Sugar?

New research links diabetic symptoms with a reduced likelihood of forgiving others.

By Tom Jacobs

Symptoms of diabetes are linked with a reduced likelihood of forgiveness, new research shows. (istockphoto.com)

By now, we've all been alerted to the warning signs of diabetes. Frequent urination. Unquenchable thirst. Tingling in the hands and feet.

And, of course, a tendency to hold a grudge.

Writing in the journal *Personality and Individual Differences*, a research team led by University of Kentucky social psychologist C. Nathan DeWall links symptoms of Type-2 diabetes to lower levels of forgiveness. Their study suggests low levels of blood glucose are not only dangerous to your health: They may also be poisonous to your personality.

DeWall and his associates describe four experiments testing their thesis, three of which featured 511 volunteers (average age 28) who participated in an Internet survey. They first completed the revised Diabetic Symptoms Checklist, which measures the number and severity of a variety of diabetes symptoms. (Examples include "Numbness or loss of sensation in the feet" and "Shortness of breath at night.")

Their willingness to forgive was then measured using three different scales. First, they filled out a 10-item survey measuring the degree to which they are predisposed to pardon. It featured questions such as "I can forgive a friend for almost anything."

Second, they reported their likely forgiveness level in five hypothetical scenarios, such as "Would you forgive a person who revealed something you told them in confidence?" Third, they reported to what degree they had actually forgiven someone who recently hurt them.

The researchers found a positive correlation between diabetic symptoms and a tendency to be unforgiving in both the real and hypothetical situations. They also found a negative correlation between the symptoms and one's general tendency to forgive.

For the fourth and final study, participants (182 volunteers) played a computer game in which they could respond to their partner's negative behavior by either forgiving them and moving on, or by retaliating and becoming uncooperative themselves. "As expected, diabetic symptoms correlated negatively with cooperative behavior," they write.

While conceding their findings measure correlation rather than causation, DeWall and his colleagues point to low blood glucose levels as the likely trigger for these resentful attitudes.

"Glucose is fuel for the brain," they write. "All brain activities require at least some glucose, but tasks that require self-control require large quantities of glucose." As we've previously reported, self-control appears to be a limited resource; DeWall notes it is also "a crucial factor in promoting forgiveness," in that it inhibits "potentially destructive impulses."

People with Type-2 diabetes have a reduced ability to efficiently process glucose, which presumably reduces their ability to exert self-control. This can lead to a negative spiral on a personal level — it's harder to stay on a diet if your self-control mechanism is damaged — but this study suggests it also has negative ramifications in the social sphere.

We all know the diabetes rate is increasing, and many commentators have complained we're becoming a less-cordial society. Is it possible these two trends are connected?

http://www.miller-mccune.com/culture/forgiveness-resentment-and-blood-sugar-20765

Bedroom Layouts Reflect Ancestors' Preferences

German researchers find evolutionary logic behind the way we lay out our bedrooms.

By Tom Jacobs

Our placement of bedroom furniture reflects the safety concerns of our distant ancestors. (Intiaz Rahim/Flickr.com)

As evolutionary psychologists persistently point out, vestiges of our prehistoric past often turn up in unexpected places. Newly published research suggests one of them may be your bedroom.

A German study finds our preferences regarding the placement of bedroom furniture reflect the safety concerns of our distant ancestors. According to the paper, just published in the online journal *Evolutionary Psychology*, our choice of room layout is remarkably consistent with the physical environment prehistoric men and women preferred.

University of Munich psychologists Matthias Spörrle and Jennifer Stich conducted an experiment featuring 138 volunteers, divided in half between men and women. (Median age was just under 30.) Each was presented with one of four floor plans for a bedroom.

Half of the rooms featured a door that opened to the right; the others had a door that opened to the left. Half had a window; the rest did not. Participants were presented with movable symbols representing items of furniture — a bed, table and chair — and asked to arrange the room to their liking.

Spörrle and Stich were curious to see whether their choices would reflect an ingrained urge to feel safe from predators. Although our earliest human ancestors slept under somewhat different conditions — for one thing, they did not spend much time worrying about the thread counts of their linens — the researchers argue we think of our bedrooms "in a similar way as our ancestors might have perceived, for instance, caves and their entrances."

They note that, for cave dwellers, nighttime safety "can be maximized by choosing a sleeping place that (a) allows one to detect a potential aggressor as early as possible, (b) allows one to remain hidden from the

aggressor as long as possible, and (c) allows for maximum reaction time in case of an attack." Are our design choices driven by those same ingrained needs?

The study suggests they are indeed. Spörrle and Stich found 83 percent of the participants "positioned the bed in such a way that it offered a view of the door from the resting position," allowing them to quickly recognize an intruder.

Seventy percent of the participants "positioned the bed to the wall opposite the door without leaving space between bed and wall," they report. "Hence, a significant majority of the participants chose the maximum possible distance between bed and door."

Finally, 74 percent positioned the door on the left side of the room if the door opened to the left, while 64 percent positioned it on the right side of the room if the door opened to the right. This placement allows those in bed to detect when the door is opened "without being immediately visible to the person entering the room."

The evolutionary roots of these preferences are clear enough: Early men and women who adopted this safe-sleeping approach were more likely to survive and reproduce, so we are effectively their ancestors. But are there other, more mundane explanations for these likes and dislikes?

Spörrle and Stich argue such preferences are "difficult to explain purely in terms of considerations of functionality." They grant that positioning of the bed might "be influenced by intentions to avoid a draft" emanating from the room's entrance. But moving the bed as far from the door as possible, and choosing to sleep at the side of the room to which the door opens, are both "counter to convenience," since they result in "a longer walk to open the door."

Eye-opening stuff, to be sure, especially since this appears to be the first study to ever examine this issue. One question remains, however: Do these evolutionary imperatives overlap with the ancient – and trendy – precepts of Feng Shui? Comparing the two could make for a fascinating follow-up.

http://www.miller-mccune.com/culture/bedroom-layouts-reflect-ancestors-preferences-20325

Oxytocin Increases Trust — Under Certain Conditions

Researchers report effects of the "trust hormone" get negated when a partner is perceived as dishonest.

By Tom Jacobs

New research suggests that the effects of oxytocin, or the "trust hormone," are negated when a partner is perceived as dishonest. (Chris Sandowski / istockphoto.com)

Oxytocin, the subject of this month's *Miller-McCune* magazine cover story, has been called "the love hormone" or "liquid trust." As our Michael Haederle reports, raising levels of the neuropeptide has been shown to make people more altruistic and generous.

Before we start putting this stuff into the water, however, it's worth asking the question: Does it also make us more gullible? Trust is great, but not everyone is trustworthy.

A research team led by psychologist Moira Mikolajczak of the Universite catholique de Louvain in Belgium addressed that question in a study, which was recently published in the journal *Psychological Science.* The researchers conducted an experiment featuring 60 young men, half of whom inhaled a dose of oxytocin 45 minutes ahead of time. The others were given a placebo; no one knew which group they were in.

The participants then played a variation on a standard Trust Game. Each played the role of an investor, who had the option of handing over some or all of his money to a trustee. This procedure gave each investor a chance to triple his money — but only if the trustee was reliable and fair. If the trustee was dishonest, he could lose it all.

Before each round of the experiment, participants were given a brief description of their trustee. “We combined trustworthy academic fields (philosophy) and activities (practicing first aid) to make some partners seem reliable, and untrustworthy academic fields (marketing) and activities (playing violent sports) to make other partners seem unreliable,” the researchers report.

After some practice rounds in which a computer played the role of trustee (returning random amounts of money), each participant played 10 rounds with 10 different partners — five trustworthy and five untrustworthy.

Not surprisingly, participants invested less money with the untrustworthy trustees, regardless of their oxytocin levels. But the hormone did have a distinct effect.

Playing with either the computer or with a reliable human partner, those who had inhaled oxytocin invested more of their money. The hormone apparently made them more trusting of the outcome and more likely to take a risk.

However, with the untrustworthy partner, those with his oxytocin levels invested slightly less than the other test subjects. The hormone “completely lost its trust-enhancing effect” when the participants were skeptical of their partner’s honesty.

The researchers call this a crucial distinction. After all, they note, gullibility potentially “exposes one to financial exploitation and even sexual abuse.”

Their conclusion: “Oxytocin is not the magical ‘trust elixir’ described in the news, on the Internet or even by some influential researchers.” Rather, its effects are context-dependent — which is a good thing.

http://www.miller-mccune.com/culture/oxytocin-increases-trust-under-certain-conditions-20586

Children's Pop-Up Books Flop as Learning Tool

New research finds children learn less from pop-up books than they do from old-fashioned volumes illustrated with photos.

By Tom Jacobs

New research finds youngsters learn more by leafing through traditional books — ones where the illustrations stay on the page. (Darren W/Flickr.com)

Around the mid-1960s, publishers decided that old-fashioned children's books — the kinds with large-type print and colorful photographic illustrations — were passé. Led by Waldo Hunt and Bennett Cerf, they revived the 19th-century concept of pop-up books, which allowed young readers to create three-dimensional worlds by simply pulling a tab or turning a page.

Their guiding belief was that these books were more interactive and thus more engaging to young readers. While that may be true, it fails to address a crucial point: Many, if not most, children's books are meant to be educational. And new research finds youngsters learn more by leafing through traditional books — ones where the illustrations stay on the page.

A research team led by University of Virginia psychologist Medha Tare came to this conclusion after performing two experiments, which are described in the *Journal of Applied Developmental Psychology*. The first featured 54 children, ages 18 to 22 months. (The researchers report eight additional children were

excluded from the study “due to fussiness,” a phrase one doesn’t encounter nearly enough in academic research papers.)

With an experimenter by his or her side, each child spent three to five minutes looking through a picture book about animals. One-third of the kids saw a book illustrated with photographs; one-third saw a book illustrated with drawings; and the final third saw a pop-up book. Those in the pop-up book group were encouraged to interact with the volume’s manipulative features, such as lifting flaps that caused the animals to move.

The experimenter made special mention of one “target animal” for each child (either a parrot or flamingo), pointing it out and repeating its name several times. Afterward, the kids were given a series of tests to see how much information they had retained.

Specifically, they were presented with two bird images (which were different from the illustrations they had seen) and two miniature bird toys, then asked to pick out the bird the experimenter had previously pointed out.

Those exposed to the book with the photographic images were able to correctly identify their bird nearly 80 percent of the time. Those who saw the book with the drawings did so around 70 percent of the time. But those who were entertained by the pop-ups did so only 50 percent of the time — no better than chance.

A second experiment featured 48 children ages 27 to 32 months. Like their younger counterparts, they looked through one of the three books. As they did so, the experimenter pointed out certain facts, such as “chicks like to eat worms” and “monkeys like to eat bananas.” They were later asked to recall this information, answering such questions as “Which one likes to eat worms?”

The results mirrored those of the first experiment. The kids who looked at the photo-illustration book did the best, while those exposed to the pop-up book did the worst.

Why were the pop-ups relatively ineffective as a learning tool? Tare and her team, which included veteran research psychologist Judy DeLoache, point to earlier research suggesting that when children “have been encouraged to manipulate and play” with something, it becomes harder for them to grasp the fact that object is actually a symbol of something else (say, a picture of a parrot). They’re more focused on the object they’re manipulating and less concerned with what it’s supposed to represent.

In addition, “the children’s manipulation of the flaps and pull-tabs on the page might have increased their cognitive load such that they could not additionally process what the adult was saying about the content of the book,” they write. “Because it did not have such distracting elements, and had more detailed images, learning labels and facts from the realistic book may have been an easier task.”

The researchers conclude that while pop-up books “may have their place as entertainment,” their “bells and whistles” approach appears to be counterproductive to learning. “When attempting to convey information to young children,” they add, “less is more.”

http://www.miller-mccune.com/education/childrens-pop-up-books-flop-as-learning-tool-20691

Great Expectations Create the Best Teen Scholars

There's a lot of ways parents can help their teenagers achieve, but research suggests the most effective way is expecting them to try their best.

By Kathy Seal

Soka University psychologist Esther S. Chang says parental involvement matters a great deal during college years. (Cryptic Star/Flickr)

"Cut that cell phone umbilical cord, and push those kids out of the nest!" may be the zeitgeist message to parents of teenagers, but research shows the opposite: Kids do better when their parents stay involved with them during their teenage years and even throughout college.

In his book *Under Pressure: Rescuing Our Children from the Culture of Hyper-parenting*, Carl Honoré skewers parents with chapter headings such as "It's the Adults, Stupid" and "Leave those Kids Alone."

"Leave them alone" is likewise Tom Hodgkinson's rallying cry in *The Idle Parent: Why Less Means More When Raising Kids*.

Such advice reinforces a common but erroneous belief that parental influence has a negligible effect on teenagers. "Once kids hit age 13, parents think they can't make much of a difference — but, in fact, parents

make some of their most vital contributions when kids are teenagers," says William Jeynes, a psychologist and professor at California State University, Long Beach.

Jeynes analyzed 52 studies of parents' involvement with their eighth- to 12th-graders to see what benefits teens most. Surprise: Checking up on their friends or setting household rules didn't top the chart.

The single most important factor affecting teenagers' academic achievement, Jeynes discovered, is their parents' expectations.

His previous research found expectations crucial for younger children too, but this study found they impact teenagers even more: by three-quarters of a grade point on a four-point scale, compared to a half-point for elementary school kids.

"It was unbelievable — my eyes widened," Jeynes says. He'd anticipated that tactics like checking up on homework or attending sports events might decline in impact, but not that more subtle forms like expectations would increase.

Preserving the subtlety of these expectations is crucial, Jeynes says. Blurting out, "You will go to Harvard or Yale" doesn't help so much as the implicit understanding that teenagers are going to put out their best effort. Parents can convey that expectation by example, and by talking about others who have also succeeded through hard work.

Contrary to media harping on helicoptering and over-involvement, communication with parents has the second-largest impact on teenagers. Talking with teens, Jeynes found, affects their grades by almost a third of a point.

Parental involvement also affects teens' behavior and self-esteem, adds Clark University psychologist Wendy Grolnick. (Grolnick and this writer co-authored *Pressured Parents, Stressed-out Kids: Dealing with Competition While Raising a Successful Child*.)

In a study of families with children entering seventh grade, she asked parents whether they attended school events and teacher conferences, and if they talked to their children about current events or took them to the library. Grolnick also asked parents if they knew when report cards were coming out, what their kids were doing in school, and the names of their classmates.

Participating in school events and conferences didn't seem to prevent problems, the study found. But kids whose parents knew what was going on in their lives, and discussed ideas and events with them, not only did better academically but behaved better and maintained their self-esteem as they hit the teen years.

Since this transition to adolescence brings drastic developmental changes, researchers stress however that parents need to shift their involvement gears accordingly.

But that doesn't mean checking out or "letting go."

Instead, parents need to step up their communication and expectations in a particular way, says Harvard education professor Nancy E. Hill. Her own meta-analysis of 50 studies of parental involvement with their middle school children found that while parents participating in school activities helped a bit, "academic

socialization" — guiding and grooming kids for academic success — influenced their academic achievement far more. This suggests that for homework, for example, explaining how it fits into their future can be more valuable than helping them do it.

Emphasizing the importance of education to teens' futures, especially how it will help them pursue their interests and exercise their talents, is critical, Hill says. Talk to teens "about their strengths, potential, and goals, and you'll see their faces light up," she says.

Parents should also express their expectations through "parental advocacy" — helping teens navigate the pathway to college, adds Hill, who co-edited the recently published *Families, School, and the Adolescent*.

As the Obama administration, in re-authorizing the federal No Child Left Behind law, proposes doubling funding to schools for parental involvement policies to approximately $270 million, policymakers might take heed of this recent research. (The administration also wants statewide competitions for the best local family involvement programs.)

Legislators might, for example, require middle schools and high schools to show parents how course selection opens or closes the doors to college. Full-fledged summer high school orientation programs for families could introduce parents to counselors, suggests Anne T. Henderson, senior consultant at the Annenberg Institute for School Reform and an adviser to the aptly named parentinvolvementmatters.org. Parents would learn about the school structure and about college preparation, including how to get financial aid. "Parents need to understand the rules of the game," Hill says.

Such orientation programs could also dispel the common misunderstanding that high school graduation and college-entry requirements overlap, Henderson says. Workshops could also help parents link school learning to their teen's interests and their long-term goals.

But parental involvement shouldn't stop with high school graduation. It matters greatly during the college years, says Soka University psychologist Esther S. Chang, who recently asked 515 students about their parents' involvement in their lives. Did their parents support the way they managed their school activities and cheer them up when they had problems at school? Did the students seek support from their parents after making important educational decisions?

Chang found that the greater the parental support, the higher the student's GPA. And students' motivation and satisfaction with their educational progress tracked even more closely with their parents' involvement.

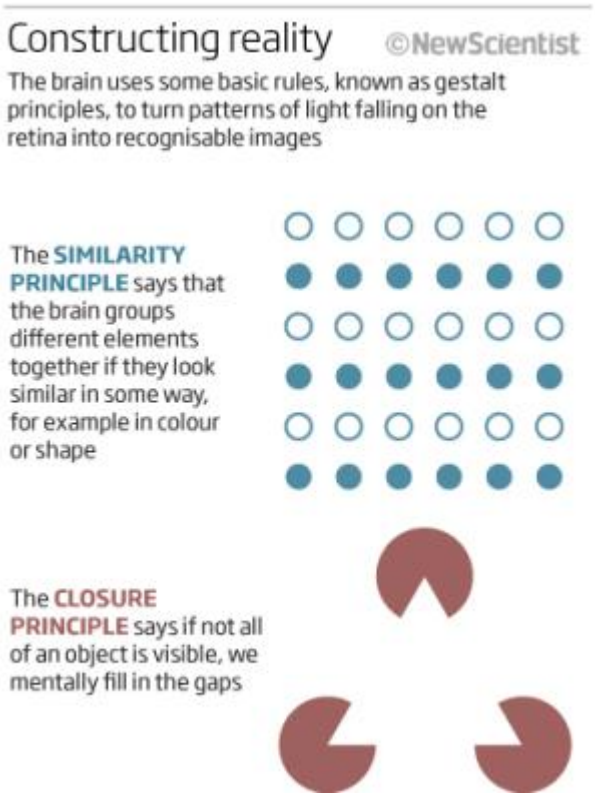
"The view out there is that parents don't really matter in college and youth don't want their parents involved in their lives," Chang says. "That's certainly not true."At the same time, Chang found that students' feelings of autonomy played a decisive role. When parents encouraged their children's interests and choices rather than trying to micromanage their course selection and daily activities, students felt more satisfied with their learning. Such satisfaction translates into the students "finding themselves" — linking their interests to their strengths and their programs, explains Chang. That in turn helps them plan their careers.

"If you want to understand how to parent youth in college, you have to accommodate the child and what the child wants, let go of your own goals for your child and support the child willingly."

http://www.miller-mccune.com/education/great-expectations-create-the-best-young-scholars-19451/

The mind's eye: How the brain sorts out what you see

- 25 August 2010 by **David Robson**
- Magazine issue 2775.



Constructing reality

Can you tell a snake from a pretzel? Some can't – and their experiences are revealing how the brain builds up a coherent picture of the world

AFTER her minor stroke, BP started to feel as if her eyes were playing tricks on her. TV shows became confusing: in one film, she was surprised to see a character reel as if punched by an invisible man. Sometimes BP would miss seeing things that were right before her eyes, causing her to bump into furniture or people.

BP's stroke had damaged a key part of her visual system, giving rise to a rare disorder called simultanagnosia. This meant that she often saw just one object at a time. When looking at her place setting on the dinner table, for example, BP might see just a spoon, with everything else a blur (*Brain*, vol 114, p 1523).

BP's problems are just one example of a group of disorders known collectively as visual agnosias, usually caused by some kind of brain damage. Another form results in people having trouble recognising and naming

objects, as experienced by the agnosic immortalised in the title of Oliver Sacks's 1985 best-seller *The Man Who Mistook His Wife for a Hat.*

Agnosias have become particularly interesting to neuroscientists in the past decade or so, as advances in brain scanning techniques have allowed them to close in on what's going on in the brain. This gives researchers a unique opportunity to work out how the brain normally makes sense of the world. "Humans are naturally so good at this, it's difficult to see our inner workings," says Marlene Behrmann, a psychologist who studies vision at Carnegie Mellon University in Pittsburgh, Pennsylvania. Cases like BP's are even shedding light on how our unconscious informs our conscious mind. "Agnosias allow us to adopt a reverse-engineering approach and infer how [the brain] would normally work," says Behrmann.

Although we may not give it much thought, our ability to perceive our world visually is no mean feat; the most sophisticated robots in the world cannot yet match it. From a splash of photons falling on the retina - a 3-centimetre-wide patch of light-sensitive cells - we can discern complex scenes comprising multiple items, some near, some far, some well lit, some shaded, and with many objects partly obscured by others.

The information from the photons hitting a particular spot on the retina is restricted to their wavelength (which we perceive as colour), and their number (which determines brightness). Turning that data into meaningful mental images is a tough challenge, because so many variables are involved. For example, the number of photons bouncing off an object depends both on the brightness of the light source and on how pale or dark the object is. "The information that the visual system receives is very impoverished," says Behrmann.

It is in the visual cortex, located at the back of the brain, where much of the processing goes on. When items obscure each other, the brain must work out where one thing ends and another begins, and take a stab at their underlying shapes. It must recognise things from different perspectives: consider the image of a chair viewed from the side compared with from above. Then there's the challenge of recognising novel objects - a futuristic new chair, for example. "Somehow, almost magically, we derive a meaningful interpretation of complex scenes very rapidly," says Behrmann. "How we do this is the million-dollar question in vision research."

So how does the brain work its magic? In the early 20th century, European psychologists used simple experiments on people with normal vision to glean some basic rules that they called the "gestalt principles". For example, the brain groups two elements in an image together if they look similar, having the same colour, shape or size, for example. And if not all of an object is visible, we mentally fill in the gaps - that's the "closure principle" (see "Constructing reality").

The gestalt principles can only go part of the way to describing visual perception, though. They cover how we separate the different objects in a scene, but they cannot explain how we know what those objects are. How, for example, do we know that a teacup is a teacup whether we see it from above or from the side, in light or in shadow?

It's here that people with visual agnosias come in handy. Behrmann had previously studied people with integrative agnosia, who have difficulty recognising and naming complex objects as a whole, and instead seem to pay unusual attention to their individual features. One person, for example, mistook a picture of a harmonica for a computer keyboard, presumably thinking the row of air-holes in the mouthpiece were computer keys (*Journal of Experimental Psychology: Human Perception and Performance*, vol 29, p 19). Others have mistaken a picture of an octopus for a spider, and a pretzel for a snake.

In 2006, Behrmann put one of her patients, known as SM, through a series of experiments alongside people with normal vision. All were shown a set of three-dimensional objects on a screen, each made from two simple geometric shapes. Afterwards, the volunteers were shown a stream of these images, with a few new objects thrown in. Their task was to report whether or not they had seen the objects before.

While those with normal vision performed with nearly 100 per cent accuracy, SM made some intriguing mistakes. He knew he hadn't seen an object before if it contained a new part, but those that had the same parts in a different configuration confused him. About half the time he mistook these for the familiar objects (*Journal of Experimental Psychology: Human Perception and Performance*, vol 32, p 1169).

To Behrmann, the results suggest that our brains normally construct objects from a series of smaller building blocks, which she calls our "visual vocabulary". To recall our concept of an object, she says, we form a mental map of the way these parts fit together. It was at this stage that SM failed. "He had a good representation of the parts, but understood little of how they were combined," Behrmann says.

Behrmann's work could help resolve a long-standing dispute among vision researchers. One theory has it that to interpret what we see, we flick through a mental catalogue of objects we have seen before - and preferably, a view of these objects from every vantage point - to try to find a best fit with the current image. Behrmann's study lends weight to a different view, that we remember the typical form of an object as a construction of a few generic building blocks.

Essential elements

It would be quicker to try to match a new object to a building block construction than flick through a catalogue of every single example of the object we've ever seen, Behrmann says. Importantly, the basic building blocks, and their configuration, would probably stay the same whether we view the objects from different angles or in different lighting, making the comparison and recognition easier and more robust.

After object recognition comes the next stage of visual perception: conscious awareness of what we see. Other kinds of agnosia have posed some serious questions about this process. "Agnosias are a breakdown in the unity of consciousness," says Rocco Gennaro, a philosopher studying consciousness at the University of Southern Indiana in Evansville. "It leads to an inability to perceive the coherent whole."

These disorders are a breakdown in the unity of consciousness, an inability to see the coherent whole

Take the case of visual form agnosia. People with this disorder cannot consciously discern the shape, size or orientation of objects, yet they have no problem manipulating those objects. Studies have shown that, for example, while they could not describe the angle of a slot in a specially built mailbox, they had no difficulty posting an object through it.

Intriguingly, there are also people with the opposite problem: they can describe the shape and size of an object, but with manual tasks they are clumsy, often missing the thing they are reaching for. This condition has been termed optic ataxia.

Brain scans have revealed that people with visual form agnosia tend to have damage to the ventral (lower) part of the brain's visual area. People with optic ataxia, on the other hand, have damage to the dorsal (upper) part. This led to the idea that we have two streams of visual processing. The ventral pathway is necessary for

perceiving or recognising an object, while the dorsal pathway deals with an object's physical location in our visual field and, if we need to perform an action on it, guides the movement of our bodies. For this reason, scientists often refer to the two processes as the perception-action, or the what-where, streams of visual processing.

This idea was necessarily based on studies of just a few people. To make matters worse, most of the cases of visual form agnosia arose from carbon monoxide poisoning, which can cause widespread brain damage, so it was hard to work out which part of the ventral pathway was most affected.

So for some time the search was on for an agnosic with just a small area of damage to their ventral pathway. Last year Hans-Otto Karnath, a cognitive neuroscientist at the University of Tübingen in Germany, found a stroke patient with damage only to the central structures of the ventral pathway. Besides providing further evidence for the perception-action theory of vision, this person's symptoms suggest that this area is vital for our normal understanding of shape and contour information (*Journal of Neuroscience*, vol 29, p 5854).

In fact, the closer neuroscientists look, the more modular our visual systems appear. MRI scans of people with and without agnosias have suggested that within the ventral stream, separate aspects of appearance are processed independently. This year, psychologist Cristiana Cavina-Pratesi at Durham University in the UK found that shape, texture and colour are all processed in individual regions (*Cerebral Cortex*, DOI: 10.1093/cercor/bhp298).

Yet our experience feels markedly different. When we consciously see something, all these disparate elements are stitched seamlessly together, so we know instantly that an apple is smooth, green and round. The question of how we accomplish this is central to the study of conscious perception.

Some neuroscientists, like H. Branch Coslett at the University of Pennsylvania in Philadelphia, think that the brain binds all the different features from the ventral stream to a "master map of location", which is held in the dorsal stream. This binding process is so fundamental, he claims, that it is only once this link has been formed that an image can pop into our consciousness; without it, images lurk somewhere in the subconscious.

Coslett says that evidence for the binding theory comes from people with simultanagnosia, such as BP, who can only see one object at a time. These people tend to have damage to the posterior parietal lobe (PPL), which may be crucial for linking information processed by the dorsal and ventral pathways. The damage appears to reduce the amount of information that can be bound together, meaning affected individuals can only bind enough data for one object at a time, while everything else remains beyond conscious reach.

Further support for the idea came in 2008, when Coslett discovered a simultanagnosic man who had damage to his PPL, leading to some curious symptoms. Like other simultanagnosics, the man, known as KE, could only see one object at a time but, uniquely, he struggled to see more than one aspect of an object at a time. In one experiment, for example, he could report an object's shape or patterning, but not both at once. When he read words written in coloured ink, he could read the word but not report the colour (*Journal of Cognitive Neuroscience*, vol 20, p 36).

Yet KE was not completely blind to the features he couldn't describe. In another experiment, he was asked to say what was depicted in line drawings of objects like lemons and tomatoes. Sometimes, these images were coloured appropriately - the lemon would be yellow, for example - while others would be mismatched. Although KE reported seeing no colour when naming the figures, his accuracy was better when the objects had the right colour, showing that some colour processing was occurring in his subconscious.

All of this fits with the binding theory. "KE could only link one channel - the colour, shape, or name of an object - to the 'where' information at any one time," says Coslett. Without the necessary binding to the dorsal map, however, all of the other features were unavailable to his conscious mind.

What lies beneath

These findings seem to support the view emerging from several disparate fields of neuroscience - that the subconscious mind has a bigger role than previously supposed. When it comes to the mental faculties we prize as uniquely human, including creativity, language and aspects of memory and learning, subconscious thought processes are far from playing second fiddle to the conscious mind (*New Scientist*, 1 December, 2007, p 42).

The subconscious has a bigger role than we thought in the mental faculties we prize as uniquely human

To Coslett and other neuroscientists studying consciousness, our attention is like a spotlight that points to a specific location in our visual representation of the world around us. As the spotlight hits a particular region, it selects the relevant information bubbling away in our subconscious, binding the different features to their location, before they pop into our consciousness as a single, unified experience.

So important is the role vision plays in most people's everyday lives that most research has concentrated on visual agnosias. Now the hunt is on for similar disorders that affect the other senses. Recently, for example, neurologists found a person who could understand speech but not other sounds. Coslett, meanwhile, is investigating whether simultanagnosics also have trouble binding other sensory sensations together, such as sights and sounds.

Understanding such deficits could reveal how the brain processes different types of sensory information. Indeed, Behrmann hopes that working with a wider range of senses might reveal general principles of sensory perception.

Press even further down this road and we could unlock one of the most fascinating mysteries of modern neuroscience: how the brain binds together all of our disparate sensory experiences into the single, flowing conscious experience that we call "the present moment".

Now you see it...

There are many visual disorders, typically caused by damage to specific parts of the brain.

- Simultanagnosia - Seeing only one object at a time, even when viewing a scene comprising many items
- Integrative agnosia - Inability to recognise whole objects, tending to focus instead on individual features of an object
- Visual form agnosia - Inability to describe the shape, size or orientation of objects, yet exhibiting no problem in manipulating them

- Optic ataxia - Ability to report the shape and size of an object, though attempts to manipulate it are clumsy
- Prosopagnosia - Failure to recognise the faces of familiar people
- Pure alexia (aka agnosia for words) - Inability to identify individual characters or read text, even though subjects are sometimes able to write
- Agnosia for scenes - Inability to recognise known landmarks or scenes
- Colour agnosia - Ability to perceive colours without being able to identify, name or group them according to similarity

David Robson is a features editor at New Scientist

http://www.newscientist.com/article/mg20727751.200-the-minds-eye-how-the-brain-sorts-out-what-you-see.html?DCMP=NLC-nletter&nsref=mg20727751.200

Ikiztepe archaeologist: Bronze Age brain surgery

- 25 August 2010 by **Jo Marchant**
- Magazine issue 2775. **Subscribe and save**
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Önder Bilgi talks about his discovery of a razor-sharp 4000-year-old scalpel and what it was originally used for

Where are you digging?

At an early Bronze Age settlement called Ikiztepe, in the Black Sea province of Samsun in Turkey. The village was home to about 300 people at its peak, around 3200 to 2100 BC. They lived in rectangular, single-storey houses made of logs, which each had a courtyard and oven in the front.

You have found what appear to be scalpels.

That's right. We have just found two cutting blades made of obsidian, a volcanic glass that forms a sharp edge when it fractures. The obsidian must have been imported from another region as there is no natural source of it in the area. We found the blades next to a circular clay platform that may have been used for religious ceremonies. The blades are double-sided, about 4 centimetres long, and very, very sharp. They would still cut you today.

What makes you think they were used for surgery?

We have found traces of cuts on skulls in a nearby graveyard. Out of around 700 skulls, 14 have these marks. They could only have been cut with a very sharp tool. At this time, 4000 years ago or more, it could only have been an obsidian blade. The cut marks show that a blade was used to make a rectangular opening all the way through the skull. We know that patients lived at least two to three years after the surgery, because the skull has tried to close the wound.

Have you uncovered any clues to why this surgery was performed?

There seem to be three main reasons. The first is to relieve the pressure of a brain haemorrhage; we found traces of blood on the inside of some of the skulls. The second is to treat patients with brain cancer, as we can see pressure traces from the cancer inside some of the skulls. And the final reason was to treat head injuries, which seem to have been quite common. The people of Ikiztepe got their copper from mines in the local mountains, and we think they had to fight other local people for access to it.

Are there any other examples of such early skull surgery?

A few skulls with cut marks have been found at other Bronze Age sites in this region, but other than these I have not found any parallel. There is a Neolithic skull found at a site in central Anatolia with a hole drilled into it. But the surgeons at Ikiztepe were cutting a rectangular opening. It is a much more sophisticated technique.

What kind of items have you unearthed?

As well as the houses we have found mainly metal objects, such as weapons, tools, jewellery and religious symbols. The inhabitants were skilled at metallurgy, unusually so for the period.

You have been digging at the site for 37 years. Why has it taken so long?

Wooden architecture is much more difficult to excavate than stone architecture. It is difficult to locate it in the soil. We have to use very small tools, like brushes and spatulas. But we will continue to dig here until we reach virgin soil.

Profile

Önder Bilgi is director of excavations at Ikiztepe, Turkey. Previously he was director of protohistory at Istanbul University

http://www.newscientist.com/article/mg20727750.200-ikiztepe-archaeologist-bronze-age-brain-surgery.html?full=true&print=true

Problem-solving designs on James Dyson award

17:51 25 August 2010

The James Dyson Award has attracted engineers and designers from 18 countries, each tasked with designing something that solves a problem. Fifteen finalists will be announced on 14 September, but in the meantime, here are some of *New Scientist*'s favourites, including a life raft that produces drinking water from salty brine, and a hub system to convert a pedal bicycle into an electric-powered mobile environment monitoring station.

Firefighters' latest weapon

When wildfires take hold, the first to arrive on the scene are "quick attack" vehicles – little more than modified off-road vehicles. What little water they carry for fighting the fire can destabilise them, leaving the vehicles prone to rolling.

The Amatoya, a concept vehicle designed by Liam Ferguson of Monash University in Melbourne, Australia, offers the driver a better view of the fire from a high, central cockpit. The vehicle can carry 2200 litres of liquid in tanks just above the wheels, helping to stabilise the vehicle.
An onboard thermal imaging camera will help guide the driver into the thick of the action, where the Amatoya can do most to fight the wildfire.

(Image: Liam Ferguson/James Dyson Award)

http://www.newscientist.com/gallery/dyson-designs-award

Retrofitted bicycles go electric

Students at the Senseable City Lab at the Massachusetts Institute of Technology hope to encourage more city dwellers to get on their bikes with the Copenhagen Wheel, an add-on device that turns an existing bicycle into a hybrid electric bike, while also converting them into mobile air-quality monitors.

Controlled from a user's smartphone, the red hub contains a motor, batteries and an internal gear system to help cyclists reach their destination with minimum effort. It also houses location and environmental sensors that will help build up city-wide air quality maps which other cyclists can use to plan their journey.

(Image: Senseable City Lab/James Dyson Award)

http://www.newscientist.com/gallery/dyson-designs-award/3

Clean water with light

Chlorine and iodine tablets can take about 30 minutes to sanitise dirty water. This ultraviolet sterilisation bottle – designed by Timothy Whitehead, a recent graduate of Loughborough University, UK – does the same thing in just 2 minutes.

The bottle contains a cafetière-like plunger to filter out particles larger then 4 micrometres. The clear water is then sterilised using a UV bulb powered by a wind-up generator. After 90 seconds, the water is safe to drink.

Tests demonstrate that the prototype can neutralise 99.9 per cent of bacteria and viruses.

(Image: Timothy Whitehead/James Dyson Award)

http://www.newscientist.com/gallery/dyson-designs-award/3

Water, water everywhere…

Dirty water is one problem, but salt water is equally undrinkable – a big problem if you're on a life raft. Kim Hoffman, a graduate of the San Francisco Academy of Art University, designed the SeaKettle to convert seawater into fresh water.

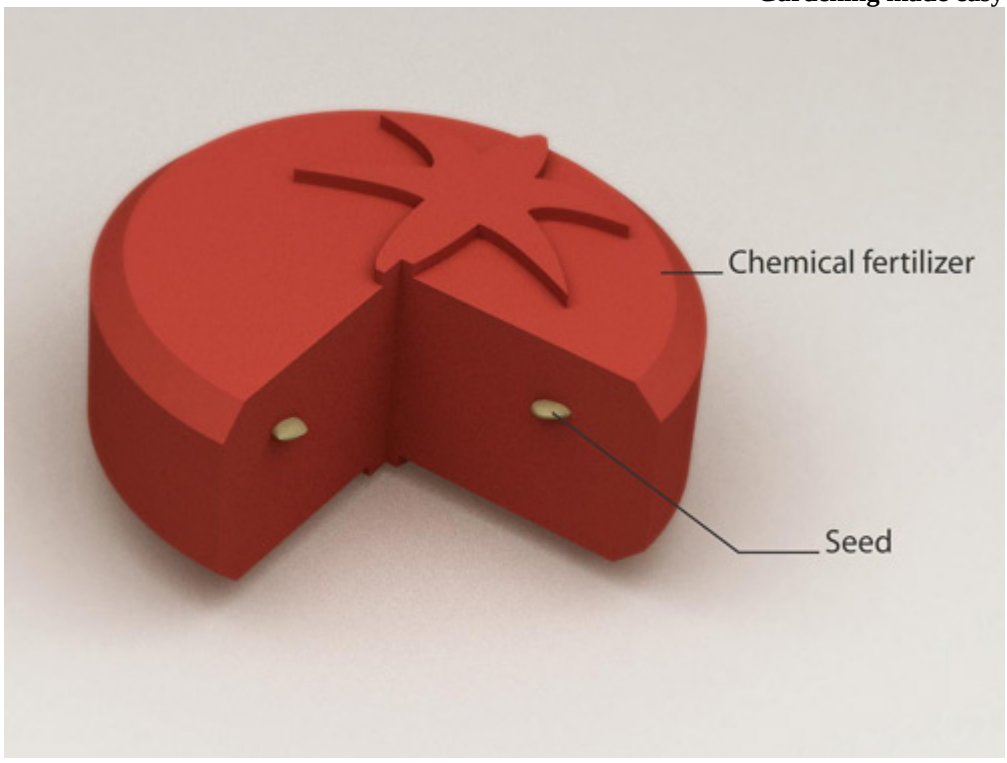
Salt water is pumped into a Gortex-covered reservoir, where it evaporates in the sun, leaving the salt behind. As the evaporated water rises, it condenses on the canopy above, before trickling down into a separate storage pocket near the base of the raft.

The raft also offers survivors protection from the sun.

(Image: Kim Hoffman/James Dyson Award)

http://www.newscientist.com/gallery/dyson-designs-award/4

Gardening made easy



These seeds come encased in chemical fertiliser to give each the boost it needs to thrive once it germinates.

The designers point out that to novice gardeners, most vegetable seeds can look alike. To help aid recognition, the fertiliser "shell" is designed to match the seeds within – in this case, tomato seeds.

(Image: James Dyson Award)

http://www.newscientist.com/gallery/dyson-designs-award/5

Infinite doppelgängers may explain quantum probabilities

- 25 August 2010 by **Rachel Courtland**
- Magazine issue 2775.

AN IDENTICAL copy of you is also reading this story. This twin is the same in every way, living on an Earth and in a universe that looks exactly like our own. And there may be an infinite number of them. Such doppelgängers could be a natural consequence of our present conception of the universe. Now, some physicists say they could pose a serious problem for quantum mechanics. But a possible fix may also be in sight, and it could help tie abstract quantum concepts to concrete physical causes.

In the uncertain, fuzzy world of quantum mechanics, particles do not have fixed properties until they are observed. Instead, objects that obey quantum rules exist in a "superposition" of all their possible states simultaneously. Schrödinger's famous cat, for example, is both alive and dead until we take a peek inside the booby-trapped box in which it has been placed.

Because the probability that the cat will be found alive is based on a quantum event - the decay of a radioactive substance within the box - it can be calculated using a principle called the Born rule. The rule is used to transform the vague "wave function" of a quantum state, which is essentially a mixture of all possible outcomes, into concrete probabilities of particular observations (in this case, the cat being alive or dead). But this staple of quantum mechanics fails when it is applied to the universe at large, says Don Page at the University of Alberta in Edmonton, Canada.

At issue is the possibility that there could be a multiplicity of copies of any particular experiment floating about the universe, just as there could be a multiplicity of yous. There could even be an infinite number of them if, as is thought, the early universe underwent a period of exponential growth, called inflation. Although this period ended very soon after the big bang in our observable region of space, inflation may have continued elsewhere, giving rise to a "multiverse", an infinite space containing infinite copies of our Earth. "In an infinite universe, every possible thing would happen, and it would happen an infinite number of times," says cosmologist Alex Vilenkin of Tufts University in Medford, Massachusetts.

Missing ingredient

Crucially, says Page, all of these copies pose a problem for the Born rule: it's unclear how to calculate the probability of different outcomes for a given experiment without first adding some extra ingredient that accounts for the multitude of copies (arxiv.org/abs/1003.2419). "You can't just plug in the Born rule and get answers that make sense," he says (see "Identity crisis").

Andreas Albrecht of the University of California, Davis, has dubbed the problem the "Born rule crisis". The shortcoming means we could not, in theory, calculate the probability of the outcome of any new measurement of the universe, such as the mass of the neutrino. "It's a deep failure of something, either of quantum theory or the multiverse," Albrecht says. "If you're a cosmologist, you should be worried," he adds.

It's a deep failure of something, either of quantum theory or the multiverse

Others, like physicist Mark Srednicki at the University of California, Santa Barbara, are not convinced there is a crisis. He says adjustments for missing information are fairly routine in quantum physics and should not require an overhaul of the theory.

A deeper problem, he says, is that we still don't understand what quantum probabilities really mean. "Quantum mechanics is now 100 or so years old, but it is still deeply mysterious," he says. "Because the concepts are so divorced from human experience, we're still not sure we're thinking of them in the right way."

Probability is treated differently in the two main interpretations of quantum mechanics. In the traditional view, observing a quantum system yields just one outcome. This view, called the Copenhagen interpretation, is a bit baffling. An initial superposition of states in a given system collapses into just one state upon being measured. Exactly why this change happens, or how the system "chooses" to be in one state or another, is unclear.

An alternative, proposed by physicist Hugh Everett in the 1950s, suggests the initial mix of states never collapses. Instead, making a measurement splits our universe into parallel versions that exist in an abstract quantum realm, and all possible outcomes occur somewhere. If a system is a mix of two equally probable states, the universe splits into two when the system is observed. But what if Schrödinger's cat is, say, 70 per cent more likely to be found alive? Does that mean the universe with the live cat would somehow be "more real" than the one in which the cat died?

Anthony Aguirre at the University of California, Santa Cruz, Max Tegmark of the Massachusetts Institute of Technology, and David Layzer of Harvard University, suspect the key to clearing this confusion could lie in the multiverse, and in tying quantum probabilities to real physical observers.

Without using the Born rule, they calculate the probabilities linked to an experiment with an infinite number of identical copies throughout the multiverse (arxiv.org/abs/1008.1066).

Imagine a quantum version of an experiment in which someone reaches into a bag containing 70 red balls and 30 blue balls. If there are an infinite number of such bags and ball-pickers, the probabilities associated with the experiment simply equate to the relative numbers of observers who find each kind of ball, says the team - in this case, 70 per cent red and 30 per cent blue. The situation is identical to one in which the same single experiment is repeated an infinite number of times. "Once you consider the combined system of all of these experiments, the probabilities come from counting up the observers and not from using the Born rule," Aguirre says.

Framed in this way, the Copenhagen and Everett interpretations look the same. The universe, filled with its infinite copies of ball-pickers, would still split into many different quantum versions in the Everett scheme. Each would have a different set of outcomes for the balls - in one version, person 1 might get a red ball and person 2 a blue, and so on up to 100 balls, for example, while in another quantum version, it might start with persons 1 and 2 both pulling out red balls. But if you counted all the balls in each quantum version, the final ratio between red and blue balls would be the same as that in every other quantum version.

That suggests that you only have to consider one quantum version of the universe, just as in the Copenhagen interpretation. Tegmark says this resolves the conundrum of how the many-worlds interpretation deals with probabilities - some do not have to be "less real" than others, as previously suggested. "All those many worlds that Everett invented are out there," he says.

"I think this is an important advance," says Vilenkin. "They showed that the mathematics really works out. It kind of clears up the foundations of quantum mechanics."

Identity crisis

Not knowing who you are is not just the cause of existential angst - it could also be the source of quantum uncertainty.

The outcomes of quantum experiments cannot be predicted exactly. Instead, a principle called the Born rule calculates the probability of each possible outcome.

The Born rule can't cope, however, if there are multiple doppelgängers running the same experiment elsewhere around the universe. It seems to need an extra ingredient, like a measure of the distribution of these doppelgängers, to work out the probability of outcomes in a given experiment.

A team led by Anthony Aguirre of the University of California, Santa Cruz, has tackled this problem without resorting to the Born rule (see main story).

They say an infinite number of doppelgängers, or copies, performing the experiment is equivalent to one observer doing the experiment an infinite number of times. This picture ties the abstract Born rule to something concrete - the existence of multiple, identical observers; a possibility that could arise if our universe is large.

In their scheme, some of these copies would get one outcome in a quantum experiment and others another outcome, with the relative numbers agreeing with the Born rule. So instead of a single observer who doesn't know the outcome of an experiment ahead of time, in this picture multiple observers get different outcomes, and quantum uncertainty "comes from the fact that you don't know which observer you are", Aguirre says.

But the probabilistic nature of quantum mechanics is still a mystery. "At this stage, I would say it is a matter of taste whether it's 'better' to have uncertainty from the existence of inaccessible copies or uncertainty that's intrinsic to quantum mechanics," says Mark Srednicki of the University of California, Santa Barbara.

http://www.newscientist.com/article/mg20727753.600-infinite-doppelgangers-may-explain-quantum-probabilities.html?full=true&print=true

Lessons in robotics change children's perceptions

- 17:11 25 August 2010 by **Zoë Corbyn**
- For similar stories,

Meeting a real robot may disappoint (Image: Marcelo Santos/Getty)

Could teaching kids how robots are used in the real world create a new generation of designers to build revolutionary machines? That's the idea behind a new study of children's perceptions of robots.

In a study echoing the 1983 "draw me a scientist" test – in which researcher David Chambers, now of the Institute of American Indian Arts in Santa Fe, New Mexico, used drawings to highlight the differences between children's view of scientists and the reality – psychologist Corinne Zimmerman and engineer Kevin Devine of Illinois State University in Normal asked 143 schoolchildren aged between 6 and 10 to "draw a picture of a robot doing something robots often do".

The results showed a clear stereotype of robots, says Zimmerman, who presented the study at the International Society for the Psychology of Science and Technology meeting in Berkeley, California, earlier this month. The children saw them as boxy humanoids with legs and a square head, typically operating free of direct human control to engage in human-like work and play, from washing dishes and doing kids' homework to golfing, skipping and dancing – About 30 per cent of the children drew them boogieing.

No more dancing

A group of 29 children who had previously submitted robot drawings were then given lessons about what robots currently do in the real world, including a field trip to see an industrial robot. They were then asked to redraw a robot.

Subsequently, only one child drew a humanoid robot – most instead drew industrial robots doing things like food processing or building cars. "The drawings were just as creative and complex, but they lacked the fictional elements of robots," says Zimmerman.

What's more, the change in perceptions stuck. After a three-month gap, repeat robot drawings were much the same. Zimmerman believes this demonstrates the teaching "narrowed the gap" between science fiction and reality. It is more realistic to conceive of an automaton under human control than a robot with free will, she says, adding that a better grasp of real robots may help students move into related careers.

But Noel Sharkey, a robotics researcher at the University of Sheffield, UK, doubts that "damping the children's ideas" will breed a new generation of robot designers. Existing humanoid robots can perform many tasks, from caring for the elderly to folding towels, he adds.

Sharkey isn't surprised that the children's robots danced: a search on YouTube will show many real dancing humanoid robots have been built over the past 10 years, he says. "We should encourage a realistic view of robots among children, but we should not limit this so as to stifle their creativity."

http://www.newscientist.com/article/dn19364-lessons-in-robotics-change-childrens-perceptions.html

Launching the new space race

- 25 August 2010 by **Greg Klerkx**

Magazine issue 2774.

Lift-off for the space revolution (Image: Chris Thompson/SpaceX)

The next generation of aerospace entrepreneurs have begun their mission: to boldly go where NASA can't afford to go any more

ON 4 JUNE this year, under the sweltering Florida sun, hundreds of rocket-watchers cluster around the swampy fringes of Launch Complex 40 at Cape Canaveral. At 2.45 pm they get what they are waiting for: the rocket on the launch platform fires up its engines and roars into the sky. Seconds later, it is a mere flicker of light in the deep blue above, and 10 minutes after lift-off it reaches Earth orbit. By all accounts, a flawless flight.

Most rocket launches these days are routine affairs, but this one was special. It was not ordered by NASA or the US air force, and the rocket had not been built by Boeing or Lockheed Martin, the two giants of US aerospace. This was the first launch of a rocket called Falcon 9, built from scratch by an 8-year-old outfit called SpaceX. The launch wasn't just a triumph for SpaceX: it was also a giant step towards a space age in which agile start-ups will play a leading part. At least, that's the plan.

Two big changes are driving the space industry in this direction. The first is the impending end of the space shuttle era, with the last flight due some time in the next nine months. The second, and possibly more significant one, is the huge cost-cutting exercise under way in the US. Earlier this year President Barack Obama proposed cancelling the funding for NASA's $97 billion Constellation programme, which aimed to return humans to the moon. In its place, a relatively meagre $6 billion will be funnelled into speeding up the commercial development of new launchers and spacecraft that will take over where the shuttle leaves off.

NASA has long used commercial contractors to build its hardware. Texas-based Spacehab has designed and built science modules for the shuttle; Zero Gravity Corporation of Vienna, Virginia, conducts parabolic flights for microgravity research; SpaceDev, based in Poway, California, makes small and inexpensive research

satellites; and XCOR Aerospace of Mojave, California, has been contracted to develop rocket engines. But the Obama plan represents something rather different.

In the old way of doing things, NASA typically paid its contractors whatever it cost them to build the launch vehicle or spacecraft it had commissioned. It is often argued that this is why so many projects have run wildly over budget when development didn't go to plan. Under the Obama scheme, NASA and the contractor will agree a fixed price and time frame for the project, with the contractor assuming the financial risk. NASA hopes this will foster a new private industry that will fund the upfront development costs and be willing to take a high-risk, potentially high-profit gamble that their services will be bought by NASA and others.

The plan follows on the heels of a report issued last autumn by a presidential committee led by retired Lockheed Martin chairman Norman Augustine. Prompted by missed technical targets and ever-spiralling costs for Constellation, the committee concluded that the project was "perpetuating the perilous practice of pursuing goals that do not match allocated resources".

A hazardous enterprise

Constellation's supporters- among them Neil Armstrong, the first man on the moon- retorted that the programme had in fact made substantial progress and that halting it now would be a mistake. Human space flight, they argued, was an inherently expensive and potentially hazardous enterprise that cannot be done on the cheap. They saved their harshest criticisms for the committee's most significant recommendation: that commercial companies, not NASA, should ultimately take responsibility for developing and running human space flight to low-Earth orbit.

Previous commercial space projects have not necessarily offered a good precedent. The first private attempt to develop and build a space rocket, the Percheron, came to grief when the rocket exploded on its launch pad during an engine test in 1981. One of Percheron's backers, David Hannah, subsequently put together a team that in September 1982 successfully launched its Conestoga rocket to an altitude of 313 kilometres. It was the first privately backed rocket to reach space. But difficulties plagued later versions of Conestoga, and rising costs led to the rocket being scrapped.

Perhaps the most notorious of the early ventures was the Roton, a cone-shaped vehicle that sprouted helicopter blades from its nose to slow descent and control landing. Problems with the technology and a shortage of funds meant that the Roton never made it onto the launch pad, although its rotor system did carry a demonstration version across the California desert on several occasions.

Things have changed dramatically since those shaky early days. Virgin Galactic's prototype tourist vehicle SpaceShipTwo made its first flight in March this year, attached to its mother ship. The company says it has $46 million on deposit from 340 would-be space tourists, and that SpaceShipTwo remains on target for a maiden suborbital flight in 2011 or 2012. XCOR is also working on a suborbital tourism vehicle, the Lynx, as is SpaceDev with its Dream Chaser.

Of all the new crop of companies, SpaceX appears to have the most immediately promising prospects. It has 22 commercial flights on its launch manifest between 2010 and 2015, of which 10 are for customers other than NASA. The company scored more work only weeks after the maiden Falcon 9 launch, when communications satellite company Iridium agreed to pay it $492 million to launch a new fleet of satellites between 2015 and 2017. The company's founder and chief executive, Elon Musk, says its organisational structure and management style are the key to its success. "We're very Silicon Valley - low on overheads,

high in motivation. Everyone has stock options in the company, and everyone works in a cubicle, including me. We are the coming of a new generation."

Also up-and-coming is Bigelow Aerospace, based in Las Vegas, Nevada. It wants to bring crewed orbital space flight to countries that have not previously been able to afford it. Between now and 2020, the company is planning 150 commercial launches to put the inflatable space stations it has designed into orbit, where they would host researchers and space tourists. "We could go from six astronauts in orbit to 60, and then 600 as the economies of scale begin to kick in," says Michael Gold of Bigelow.

We could go from six astronauts in orbit now to 60, and then 600 when the economies of scale kick in

To launch its prototype station, called Genesis, the company turned to Russia and its Soyuz rocket. But a Falcon 9 flight will launch its first space station capable of housing a crew, called Sundancer, in 2014. Bigelow is also exploring the possibility of docking its modules to the International Space Station (ISS).

SpaceX itself has ambitions to launch crewed space vehicles on its rockets. June's Falcon 9 launch delivered a mock-up of the SpaceX Dragon capsule into orbit. The real thing should be capable of delivering both cargo and crew to the ISS.

While the financial structure of the private space industry is new, some of the technology rests firmly on what has gone before, harvesting some of the fruits of the billions of dollars invested by government space programmes in research and development. For example, Falcon 9's nine-engine design was inspired by the multi-engine Saturn V rockets that sent astronauts on their way to the moon 40-plus years ago. This design allowed the launch to continue safely if one of the engines failed, as happened on several Saturn flights. Masten Space Systems of Mojave, California, revived engine technology developed for the Apollo lunar lander for its Xoie rocket, which last year won first prize in NASA's Lunar Lander Challenge.

This is not to say that the private sector isn't innovating, too. XCOR has provided NASA with an engine that burns liquid oxygen and methane, and has also developed the rocket engines that are powering many vehicles in the nascent rocket-racing industry - an attempt to reproduce the excitement of the barnstorming competitions that galvanised interest in early aviation. Bigelow Aerospace has managed to both borrow and innovate: its inflatable Genesis I and II prototype space stations, now circling the Earth, build on 1960s-era technology that NASA had discarded at mock-up stage.

Though NASA's role is changing, it is still highly influential. Its Centennial Challenges competitions such as the Lunar Lander Challenge offer prizes for the best solution to what it thinks will be key technological challenges for the near future. Perhaps it is no coincidence that the Centennial Challenges initiative was itself modelled on a privately funded competition: the X Prize.

Baby steps

NASA's most significant nod to newer companies was the creation in 2006 of the Commercial Orbital Transportation Services (COTS) programme, which gave several firms, including SpaceX, more than $200 million to support the development of launchers and spacecraft that can carry cargo to the ISS. In a more recent phase of COTS, NASA awarded contracts to SpaceX and Virginia-based Orbital Sciences to deliver cargo, possibly beginning next year. Each company stands to earn $1.5 billion by 2016.

But even the most ambitious of the space start-ups don't expect to supplant the established aerospace giants. There are indications that the agency is not entirely comfortable about handing control to industries outside its direct sphere of influence. So long-time NASA contractor Lockheed Martin, for example, is continuing to develop a scaled-down version of the Orion capsule to act as a "lifeboat" for the ISS, augmenting or replacing the Soyuz rocket. One of the remnants of Constellation to escape Obama's axe, the project has prompted complaints that it unfairly favours Lockheed Martin. "Our Dragon capsule can serve as a lifeboat, too," says Elon Musk of SpaceX. "I don't think there's an actual need for Orion except that it's a solution to a political problem."

When it comes to carrying humans to and from the ISS, Musk accepts that Boeing and Lockheed Martin will probably continue to do most of the heavy lifting. "For commercial crew, Boeing and Lockheed will probably take the bulk of funding, with SpaceX hopefully taking a strong third place," says Musk.

What happens beyond Earth orbit is still up for grabs. The Ares I-X rocket, a survivor of the Constellation programme, which made a successful test flight in October 2009, could still be the precursor for a larger vehicle that would carry astronauts back to the moon. And earlier this month, SpaceX unveiled plans for a heavy-lift Falcon X and Falcon XX that might serve the same purpose. However, no commercial space company has announced missions beyond Earth orbit just yet. Trips to Mars and even the moon are on hold for now while NASA and its partners work out how to put people in orbit for less.

Greg Klerkx is a writer based in London

http://www.newscientist.com/article/mg20727741.500-startup-enterprise-launching-the-new-space-race.html

Wave power line jacks into the grid

- 16:00 24 August 2010 by **Paul Marks**

Wave Hub is lifted aboard the Nordica (Image: NorthNewsAndPictures/2daymedia)

Green machine *is our weekly column on the latest advances in environmental technologies.*

Surfers, bodyboarders and dolphin-spotters at the English seaside resort of St Ives were mostly unaware of a techno drama being played out about a kilometre beyond the breakers this month. Since 1 August, engineers on the cable ship Nordica have been trying to begin deployment of Wave Hub, an undersea extension cord that could make harnessing wave energy more viable. The first part of the roll-out hasn't gone at all smoothly, however.

So just what is Wave Hub? Essentially, it's a four-way socket that will be installed 50 metres down on the seabed 16 kilometres from shore, where the Atlantic swell is deemed perfect for serious energy capture, and connected via a giant 50-megawatt-capacity cable to an electricity substation in Hayle, on St Ives bay.

It will allow different designs of wave-powered generators to be compared. Giving each generator its own connection to land would be inefficient: Wave Hub will allow up to four wave-energy conversion machines to be stationed and plugged into the hub simultaneously, providing an easy way to compare how good each machine is at injecting power into the national grid on a commercial scale.

"What electric utility companies really need is such a test-bed – a place where they can test wave-energy technologies in a realistic setting and see if the economics make sense. That's what Wave Hub offers," says Max Carcas of Pelamis Wave Power, based in Edinburgh, UK.

Yellow submarine

Right now, the best UK test bed is the near-shore European Marine Energy Centre in the Orkney Islands off northern Scotland. There, 12 cables connect to wave and tidal power test sites.

"But you can't make an industry with just one machine feeding each cable," says Neil Kermode, managing director of EMEC. "To farm wave energy on a mass scale you need to aggregate the power at sea from an array of machines and convey it to the shore on one high-voltage cable. That's what Wave Hub will offer and we are working closely with them."

Wave Hub itself comprises transformers that convert the wave-generated power into a grid-usable voltage, all in a submersible yellow housing. But the process of connecting it has proved more troublesome than the project's backers – which include a regional government agency and the European Union – had anticipated.

The power cable is being spooled off a giant drum on board the Nordica, anchored 1.8 kilometres from shore. To minimise the risk of damage to the cable, it has to be floated ashore and gently winched up the beach – which took several attempts, as parts of the cable kept sinking at inopportune moments.

Sinking feeling

The contractor CTC Marine of Aberdeen, UK, had initially used 50-metre-long sausage-shaped flotation bags to float the cable because they allow for faster spooling of the cable. Unfortunately, failure of one of these long bags increases the likelihood of the heavy cable (which weighs 56 kilograms per metre) sinking – which is what happened.

What's more, the cable landing point at Hayle beach is only very gently sloping, so CTC needed a high spring tide to float the cable to the beach – but the flotation failures meant the team missed a number of high tides

After replacing the long floats with a series of smaller buoys CTC succeeded in floating the cable on the high tide at 5 am yesterday. The next step is to connect it to the grid and then send the Nordica out to sea to deploy the rest of the cable. Finally, Wave Hub itself will be placed in 50 metres of water 16 kilometres from land.

Once Wave Hub is installed, though, the South West Regional Development Agency, the public body leading the project, wants to know why the chosen flotation tech caused a three–week delay. "We will be wanting a coherent and detailed explanation," programme chief Guy Lavender told *New Scientist*.

http://www.newscientist.com/article/dn19356-green-machine-wave-power-line-jacks-into-the-grid.html

Pee is for power: Your electrifying excretions

- 24 August 2010 by **Hazel Muir**
- Magazine issue 2774.

Pee's electric (Image: Andy Martin

Why let your waste go to waste when it could be powering your mobile phone – or even your car?

IT IS a bright spring morning here at Heriot-Watt University in Edinburgh, UK, where I have come to meet my interviewee for this article, Shanwen Tao. Normally when I interview someone, I give them a business card and maybe the latest issue of *New Scientist*. Today, I give Tao a bottle of my own pee.

Chemist Tao doesn't find this odd. Urine, he believes, could help solve the world's energy problems, powering farms and even office buildings. And he has agreed to use my offering to show me how.

Urine might not pack the punch of rocket fuel, but what it lacks in energy density it makes up for in sheer quantity. It is one of the most abundant waste materials on Earth, with nearly 7 billion people producing roughly 10 billion litres of it every day. Add animals into the mix and this quantity is multiplied several times over.

As things stand, this flood of waste poses a problem. Let it run into the water system and it would wipe out entire ecosystems; yet scrubbing it out of waste water costs money and energy. In the US, for instance, waste water treatment plants consume 1.5 per cent of all the electricity the country generates. So wouldn't it be nice if, instead of being a vast energy consumer, urine could be put to use.

That thought occurred to Gerardine Botte, a chemical engineer at Ohio University in Athens, during a discussion in 2002 with colleagues about possible sources of hydrogen for use in fuel cells.

Hydrogen can be produced from fossil fuels in large quantities, but it is difficult to store and distribute. Another option is to split water on the spot, releasing hydrogen directly into a fuel cell - but here as much energy is needed to split the water as is released by the hydrogen.

Botte's brainwave was to use urine instead of water. By weight, urine contains roughly 2 per cent urea, and each urea molecule contains four hydrogen atoms, which, crucially, are less tightly bound to the molecule than the hydrogen in water. Splitting these bonds would require less energy, making hydrogen production more efficient.

Last year, Botte's team reported that they had been able to generate hydrogen from urine using an electrolytic cell with cheap nickel-based electrodes running at only 0.37 volts- much less than the 1.23 volts it takes to split water (*Chemical Communications*, 2009, p 4859). Pure hydrogen bubbled off at the cathode, while nitrogen and carbon dioxide formed at the anode.

Botte calculates that with more efficient electrodes, hydrogen could be produced from urine at a cost of less than $1 per kilogram. She thinks the technology could be useful wherever large numbers of people congregate and enough urine can be collected to make the process worthwhile. "An office building where 200 or 300 people work could produce about 2 kilowatts of power," she says.

An office where 200 or 300 people work could produce about 2 kilowatts of power from pee

Another approach is to forget about hydrogen and use urine directly as a fuel. This is the approach being taken by Tao and his colleague Rong Lan, along with John Irvine from the University of St Andrews, also in the UK. Since 2007, the team have been developing a fuel cell that can produce electricity directly from urine (see diagram). No voltage needs to be applied to break down the urea; instead, a low-cost electrode makes the reaction happen spontaneously. The details of the electrode are still secret.

Pee-cycling

Inside the fuel cell, water and air close to the 1 centimetre square cathode generate hydroxide ions, which are attracted to the anode. There they react with urea to form water, nitrogen and carbon dioxide. This reaction also generates electrons, which flow back to the cathode through an external circuit, forming a current that the team hope will one day be large enough to power electrical devices (*Energy and Environmental Science*, vol 3, p 438).

To show me the process in action, Tao and Lan add my urine to the fuel cell. As it flows into the cell, a screen shows the output voltage rising to about 0.6 volts. While this prototype is too small to power a light bulb - its output is about half that of an AA battery - scaling up the cell and connecting several cells together should produce practical amounts of power.

Tao hopes that even small urine fuel cells will one day become useful, if the right electrode materials can be found to boost their power output. They could be used to power radios or phones in remote locations, for example. "You could carry a small fuel cell for low-power mobile communications without having to carry the fuel," he says.

A larger-scale application could be found in farms. As the urine from all mammals contains urea, that from cattle, say, could be used to generate electricity to run farm buildings - assuming the cows' urine could be kept separate from other waste.

Urine from cattle, say, could be used to generate electricity to run farm buildings

This, like all the applications mentioned so far, will only work with relatively concentrated urine. That rules out the most urine produced in people's homes, which goes into the sewerage system along much larger quantities of waste water - but even this resource need not go to waste.

By the time the urine reaches a sewage treatment plant it is not only dilute, but also contaminated with a cocktail of chemicals. What's more, most of the precious urea it contains has broken down into ammonia. Nevertheless, Botte says that her technology should be able to deal with this. She plans to adapt it to split ammonia into hydrogen and nitrogen, and she hopes to secure funding within a year to test the technology at a treatment plant.

Another promising option would be to use microbial fuel cells to generate electricity from all kinds of compounds in mucky waste water, not just urea and ammonia. These devices can break down all the organic matter the water contains, cleaning it at the same time, says Bruce Logan, who develops microbial fuel cells at Pennsylvania State University in University Park.

They take advantage of the fact that waste water naturally contains bacteria and organic matter. When bacteria "consume" this food, they produce electrons that would normally combine with oxygen. But if kept in an oxygen-free chamber they can feed those electrons to an electrode and from there into an external circuit. Protons, meanwhile, pass through a membrane that divides the cell, to reach another electrode - the cathode - where they combine with the incoming electrons from the external circuit, and oxygen, to form pure water.

Experimental microbial fuel cells have generated power densities of up to 6.9 watts per square metre of electrode surface (*Environmental Science and Technology*, vol 42, p 8101). "Maybe 6.9 watts doesn't sound like a lot, but we have very large reactors in waste water treatment plants, and if you have tens of thousands of square metres, that's going to be a lot of power," says Logan. The technology is being tested at pilot plant scale.

Alternatively, these cells can be modified to produce hydrogen fuel instead of electricity by keeping the cathode as well as the anode oxygen-free. Logan's team recently completed field trials of a 1000-litre version of a hydrogen-producing microbial cell at a winery, where the waste water contained leftovers from grape crushing and fermentation, such as sugars and ethanol. Logan says the cells coped well with the real-world conditions, such as varying composition of waste water, but won't discuss the details until the work is published.

Logan is focusing on scaling up the microbial cells and finding the materials for electrodes that make them work most efficiently. "We expend a lot of energy on waste water treatment right now, and these technologies hold the promise to convert this process from an energy consumer to a net energy producer," he says.

No one claims that urine will ever be the complete answer to our energy needs, but Botte argues that the more sources we have for our energy, the better. "We have gigantic energy needs. We are talking billions of

megawatt-hours each year in the US alone," she says. "Trying to find one solution is not the answer. There is room for many technologies with different market shares."

Yellow gold

An adult produces enough urine each year to drive a car 2700 kilometres on energy from the urea it contains, according to calculations by Shanwen Tao, who develops urea-powered fuel cells at Heriot-Watt University in Edinburgh, UK. Harvesting this resource for large-scale distribution might seem problematic, but as luck would have it there is a ready-made alternative - in Europe, at least.

Since 2006, the European Union has required most diesel trucks and buses to capture the toxic nitrogen oxides produced when diesel combusts. The toxic gases react with urea to form a harmless mixture of nitrogen, water and carbon dioxide. Today, more than 6000 petrol stations and other outlets across Europe sell 32.5 per cent urea solutions under the trade name AdBlue. The system also operates in several Asian nations and the US will soon follow suit.

"The infrastructure is already there, and the cost is only around 40 pence a litre," says Tao. If you had a car powered by a urea fuel cell, "you could just go to a normal petrol station, pump in urea and drive away", he says.

Though a urea-powered car would avoid using precious fossil fuels directly, urea is currently made from natural gas, so its carbon footprint would probably be similar to a petrol-powered car. However, efforts are under way to make urea from biomass, which could lead to significant emissions savings.

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http://www.newscientist.com/article/mg20727741.400-pee-is-for-power-your-electrifying-excretions.html

Anticipation of pain makes it hurt more, even days later

- 22:00 24 August 2010 by **Jessica Hamzelou**
- Magazine issue 2775.
-

You'll hardly feel a thing. If doctors play down the pain of a procedure, patients might avoid the nocebo effect – the placebo effect's evil twin.

Arne May's team at the University of Hamburg, Germany, applied heat to the arms of 38 volunteers over six days. Half of them were told the heat would get more intense, and they reported constant pain levels. The rest felt less pain as they got used to the sensation. The first group also had increased activity in a brain area involved in pain perception.

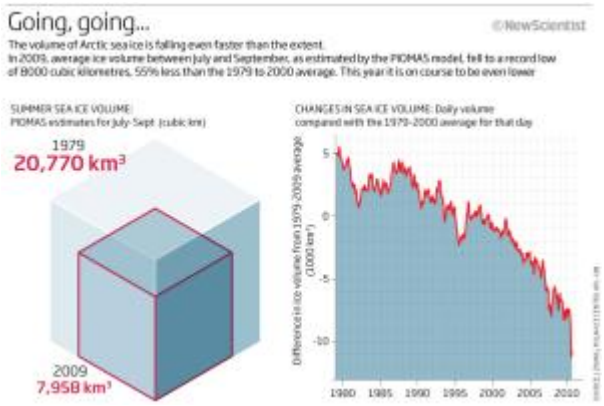
"I didn't expect that giving negative information for 5 minutes would have an effect a week later," May says.

Journal reference: *The Journal of Neuroscience*, DOI: 10.1523/jneurosci.2197-10.2010

http://www.newscientist.com/article/dn19357-anticipation-of-pain-makes-it-hurt-more-even-days-later.html

Arctic ice: Less than meets the eye

- 25 August 2010 by **Chris Mooney**
- Magazine issue 2775. **Subscribe and save**



Going, going...

The ice may not retreat as much as feared this year, but what remains may be more rotten than robust

LAST September, David Barber was on board the Canadian icebreaker CCGS Amundsen (pictured below), heading into the Beaufort Sea, north of Alaska. He was part of a team investigating ice conditions in autumn, the time when Arctic sea ice shrinks to its smallest extent before starting to grow again as winter sets in.

Barber, an environmental scientist at the University of Manitoba in Winnipeg, Canada, went to sleep one night at midnight, just before the ship was due to reach a region of very thick sea ice. The Amundsen is only capable of breaking solid ice about a metre thick, so according to the ice forecasts for ships, the region should have been impassable.

Yet when Barber woke up early the next morning, the ship was still cruising along almost as fast as usual. Either someone had made a mistake and the ship was headed for catastrophe, or there was something very wrong with the ice, he thought, as he rushed to the bridge in his pyjamas.

On the surface, the situation in the Arctic looks dramatic enough. In September 2007, the total extent of sea with surface ice shrank further than ever recorded before - to nearly 40 per cent below the long-term average. This low has yet to be surpassed. But the extent of sea ice is not all that matters, as Barber found. Look deeper and there are even more dramatic changes. This is something everyone should be concerned about because the transformation of the Arctic will affect us all.

The record low in 2007 cannot be blamed on global warming alone; weather played a big role too. That year saw a build-up of high pressure over the Beaufort Sea and a trough of low pressure over northern Siberia - a weather pattern called the Arctic dipole anomaly. It brings warm, southerly winds that increase melting. The

winds also drive sea ice away from the Siberian coast and out of the Arctic Ocean towards the Atlantic, where it melts.

In 2008 and 2009, the dipole anomaly did not dominate and the extent of ice did not shrink as much during summer. This rebound led to much talk of a recovery in Arctic ice.

This June, the dipole anomaly returned and the ice extent for the month was the lowest ever. In July, however, the dipole pattern broke up and the rate of ice loss slowed. "Whether or not we set a new record depends very much on the weather patterns," says Mark Serreze of the US National Snow and Ice Data Center based in Boulder, Colorado, which monitors the extent of sea ice - a particular way of measuring its area.

While much attention is likely to be paid to whether or not a new record is reached in the next month, there is more to sea ice than area alone. New sea ice can grow up to 2 metres thick during the winter. If it survives the summer melt, it can grow even thicker over the three to six years it might last before being swept past Greenland and out into the Atlantic Ocean, or succumbing to the summer melt. In places, this multi-year ice can pile up forming "pressure ridges" as much as 50 metres deep. But its average thickness is now less than 3 metres according to ICESat, the only satellite capable of measuring ice height and thus thickness (Geophysical Research Letters, vol 36, L15501).

There is no long-term record of the total volume of ice because we have only patchy data; ICESat was launched in 2003 and failed earlier this year. The nearest thing we have are estimates from PIOMAS, developed by Jinlun Zhang and his colleagues at the University of Washington's Polar Science Center in Seattle. Actual satellite measurements of sea ice concentration since 1978 are fed into a computer model of the growth, melting and motion of sea ice to produce an estimate of ice volume. PIOMAS's results correspond well with independent measurements by submarines and by ICESat.

According to PIOMAS estimates supplied to *New Scientist* by Zhang, the average volume of Arctic ice between July and September has fallen from 21,000 cubic kilometres in 1979 to 8000 cubic kilometres in 2009. That is a 55 per cent fall compared with the 1979 to 2000 average. "The loss of ice volume is faster than the loss of ice extent," says Zhang. His model suggests that not only has the total volume of Arctic ice continued to decline since 2007, but that the rate of loss is accelerating (see "Going, going...").

Not only has the volume of ice continued to decline, the rate of loss is accelerating

How can ice volume have kept falling when extent increased again after 2007? Because less and less ice is surviving to see its first birthday. "First-year ice is now the dominant ice type in the Arctic, whereas a few years ago multi-year ice was dominant," says Barber.

Young ice is thinner than multi-year ice, and thus more likely to break into smaller pieces that melt more quickly, and more likely to be swept out of the Arctic and into warmer seas. That is precisely what happened in 2007, when persistent winds blew a thinner ice pack through the Fram Strait between Greenland and the island of Spitsbergen, leading to the dramatic ice loss. "The same wind 30 years ago when the ice was thicker would not have done as much damage," says Bruno Tremblay, a climate researcher at McGill University in Montreal, Canada.

And while the area of young ice increased in 2008 and 2009, the amount of multi-year ice continued to fall. "There wasn't a recovery at all," Barber says.

Even the nature of the remaining sea ice might be changing. When Barber rushed up to the bridge that morning in September 2009, the first officer told him that while it looked like there was ice, it was no barrier to the ship at all. The reason: the ice was rotten.

It consisted of multi-year ice that had become riddled with surface thaw holes and had broken into pieces. Over winter, a 5-centimetre layer of new ice had formed over the dispersed floes. If a person tried standing on it they would fall right through, so it was no obstacle to the Amundsen. It is not clear how widespread these conditions are because satellites cannot distinguish between rotten and more solid ice (Geophysical Research Letters, vol 36, p L24501). The rotten ice is less of a barrier to waves as well as ships, meaning waves can penetrate further into ice packs and break up more ice.

What it all means is that, much like the Amundsen, we are now cruising effortlessly into a world that may soon feature an essentially ice-free Arctic during at least part of the year. "Thirty years from now, maybe even 20 years from now, if you were to look at the Arctic from space you would see a blue ocean [in summer]," says Serreze.

The implications of such changes for wildlife and the human inhabitants of the region, for the global climate and for geopolitics are profound. The Arctic would be traversable by ship. It would be far more open to oil and gas exploration, and mineral extraction. Its dark ocean waters, mostly devoid of ice, would absorb still more sunlight, further warming the overlying atmosphere during an increasingly lengthy ice-free season, reshaping weather throughout the region and well beyond it.

Worryingly, the melting of the Arctic sea ice is proceeding considerably more quickly than most climate models have predicted. Among the suite of models submitted for the 2007 report of the Intergovernmental Panel on Climate Change (IPCC), only two out of 23 yielded results for Arctic sea ice that were consistent with observations, says Cecilia Bitz of the University of Washington in Seattle.

According to the 2007 models, the Arctic will not become ice-free in summer until some time after 2050. However, researchers like Barber and Serreze think this landmark occurrence will come much earlier. Barber has predicted that it will occur sometime between 2013 and 2030.

If most models aren't capturing the full extent of changes in the Arctic, it is probably because the modelled feedbacks are too weak, says Bitz. In other words, they may not be sensitive enough to processes that, once they get going, self-amplify in a continuing loop.

Every model includes the "ice albedo feedback", in which the melting of ice that reflects most of the sun's heat exposes dark water that absorbs most heat. That leads to more melting and so on - a positive feedback. But there could be many others.

Consider, for instance, the role of Arctic storms. They break up ice with their winds and waves, making it more prone to melting - and the more open water there is, the more powerful waves can become. These larger waves - which were not included in any models - then penetrate further into the ice pack, breaking it up into smaller and smaller pieces, says Barber. From the bridge of the Amundsen as it sat moored in the ice last year, Barber himself watched as a large swell broke a chunk of ice the size of Manhattan into a number of pieces roughly 100 metres across.

Storms also bring snow, which in autumn and winter actually slows the growth of sea ice by insulating it from cold winds, as well as reducing heat loss from the sea below. So if climate change leads to more snow in autumn and winter, this will be yet another factor contributing to the loss of sea ice.

Bitz thinks the 2007 low was a wake-up call for climate modellers, compelling them to look more closely at how their programs handle sea ice. She expects that when the next set of models is submitted to the IPCC for its 2013 report, their outputs will be much more in line with observations. "The modelling centres are short of resources for giving focus to a particular part of the model," she says. "But when a big story comes out like 2007, they redirect, and that will pay off."

The implications of the loss of Arctic sea ice in the summer are hard to overstate. Most attention has focused on charismatic megafauna like polar bears and walruses, but they are just the icons of a broader ecosystem that is already being dramatically disrupted. The sea ice is as important as the trees to a rainforest, Barber says.

The loss of sea ice will also have many other impacts. For instance, the increase in the size of waves has already begun to cause serious coastal erosion in places like Alaska, with the effect magnified by warmer waters and rising sea level. The impact of the waves eventually melts the permafrost of which the coastline is composed. "Some of those coastlines are made of very fine silt," says Tremblay. "The land just washes away."

A warmer Arctic will also affect weather in the mid-latitudes - indeed, it has already begun. Take the Great Plains of the US. According to Michael MacCracken of the Climate Institute in Washington DC, this region's weather is very much determined by clashes between cold air masses coming down from the Arctic and warm air masses from the Gulf of Mexico. As the Arctic blasts are less cold than they used to be, the Gulf's warm air tends to push further northwards. The result is a northward shift of weather patterns, and more extreme storms and heavy precipitation events in regions not used to them.

Finally, there are the economic and industrial implications. "The engineering challenges get simpler," says Barber, "for drilling, for putting drill ships in place, for having icebreakers, to make tankers carry oil across the pole - all those kinds of challenges associated with industrial development." Such challenges will diminish, or even vanish entirely. The Amundsen's surprisingly easy voyage through the Beaufort Sea in September 2009 could be a herald of things to come.

Chris Mooney is a host of the Point of Inquiry

http://www.newscientist.com/article/mg20727751.300-arctic-ice-less-than-meets-the-eye.html?DCMP=NLC-nletter&nsref=mg20727751.300

The descent of man
16:45 16 August 2010
Books

Deborah Blum, contributor

LET me start by revealing a prejudice: I don't like book titles that end with a question mark. They make me worry that the author doesn't know the answer, that he or she is looking to the reader for homework help.

And if the question posed is *Is There Anything Good About Men?*, I want some clear conclusions, a nice strong sense of what social psychologist Roy Baumeister thinks is "good" about the Y-chromosome community. A summary of key points might be handy in case there turns out to be a quiz.

Unfortunately, that is not what we get in this book. At times Baumeister seems dubious about men's good points. "To be blunt and undiplomatic, I like women better than men," he says. He cites studies showing that people who chat with women for 10 minutes a day are happier than people who don't get that lucky chance. By contrast, conversations with men appear to be downers. "This is not to say that talking to men is bad," Baumeister adds encouragingly.

Or at least I think he is trying to be encouraging. The message is so muddled here that it is a little difficult to tell. That is partly because - or so I deduce - the real story here, the subject that Baumeister is actually passionate about, is in the subtitle *How cultures flourish by exploiting men*, which, you will notice, doesn't follow entirely logically from the question raised in the title.

When Baumeister is focused on that idea - that we have built our successful civilisation in part by treating men as expendable building blocks - then the argument gains some momentum. He notes not only that men perform the riskiest jobs in society today but that "ninety-two per cent of Americans who die in the line of work are men". And he reminds us how casually we accept that imbalance, without the outrage that might result if the statistic applied to women.

Unfortunately, even when arguing this important point, Baumeister continues to muddy the message. He proposes the not-so-revolutionary idea that men are culturally motivated to take risks - the dangerous jobs, the big gambles that allow them to become rulers of their domains. "These competitions produced immense progress in the men's sphere," Baumeister writes. For instance, men bought ships and explored the world. Women, he continues, did not do such things. Why not? They lacked motivation. "Women could have done it if they wanted to. But they did not want to."

I find it hard to believe that during the 15th and 16th centuries, when motivated males were accidentally discovering the Americas, women simply lacked the adventurous spark. Here is another possibility: could it be that not too many women in the days of Columbus and company had the opportunity to captain a ship or map a continent?

Baumeister repeats his heroic history argument - "The fact is that America's greatness was propelled by its men more than its women" - so often that one starts wondering if the answer to the question in the book's title is that there used to be something good about men, but their strengths are better suited to the past.This very idea is gaining some currency in feminist circles. But I suspect that Baumeister actually is trying to lead us in another direction. Lurking in the book, obscured by the somewhat clumsy provocation, is a fair-minded message: we should value our differences. It is not a new thought, but surely one that could bear repeating. Because if we are still asking ourselves whether there is anything good about men (or, in other circles, women) we have yet to really grasp the point.

Take note of that. We may need a quiz after all.

(Image: Design Pics Inc/Rex Features)

Book Information
Is There Anything Good About Men?: How cultures flourish by exploiting men
by Roy F. Baumeister
Oxford University Press
£15.99/$24.95

http://www.newscientist.com/blogs/culturelab/2010/08/the-descent-of-man.html?DCMP=NLC-nletter&nsref=descentofman

Learning from the wisdom of herds

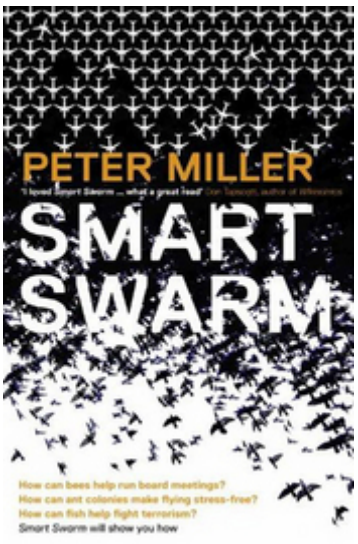
14:00 17 August 2010
Books

Samantha Murphy, contributor

If you have ever bought something because it had the most positive reviews, or joined in with a standing ovation simply because you didn't want to be the only one left sitting, then you are at least as smart as a honeybee and as steadfast as a bird in a flock. Reassuring news, as it turns out.

Peter Miller, an editor at *National Geographic*, argues that there is a lot we can learn from group behaviour in other animals. In *The Smart Swarm* he has extracted a few vital rules from research on the decision-making skills of birds, insects and fish, that can improve the way we approach even the most complex of our problems. How is it that honeybees can employ debate and democracy to decide where to relocate, when across the world boardroom meetings adjourn, week after week, without agreement? How do schools of fish

change direction in the blink of an eye without a single signal or fearless leader to guide them? Do animals know something that we have either forgotten along the way or have yet to learn?



Miller's book advocates a new kind of problem-solving: one that offers a kind of collective resilience and flexibility that we simply cannot achieve as individuals. Collective solutions have already been adapted to solve some tricky human problems. The way termites maintain a constant temperature inside their mounds has inspired climate control features in skyscrapers, and the navigation techniques of ants have been used to optimise the routes of delivery trucks. Miller also describes how one CEO got more accurate sales forecasts using the average of the best guesses of a large number of entry-level employees than from his small team of finance experts. And that's just the beginning.

The Smart Swarm blends zoology, entertaining anecdotes and conceptual discussion in an approachable and insightful way. While not all the examples are equally interesting, and some belabour the point, one cannot help but be inspired by the ideas. What would life be like if we sought to excel as a group rather than as individuals?

The book is more than a philosophical exercise. Humans have the swarm sensibility built-in; we simply haven't fully applied it. That may be because we haven't had the opportunity, until now. The collaborative possibilities opened up by the internet are bringing smart swarming to the fore. As an example, Miller cites Intellipedia - a Wikipedia-style collaborative site developed by US intelligence services, with information available at various levels of security clearance. Wiki sites have been around for a while, but now that contributors can be drawn from all parts of the globe and their numbers are climbing rapidly, we may finally be able to exploit what the birds and the bees have been up to all along.

Of course, Miller cautions, swarm behaviour in humans can have a downside, especially when it manifests as groupthink or peer pressure. He references this hilarious Candid Camera clip to demonstrate just how strong - and, at times, absurd - our instinct to conform can be.

(Image: Mike Powell/Stone/Getty)

Book Information
Smart Swarm: Using animal behaviour to organise our world
by Peter Miller
Collins/Avery
£18.99/$26

http://www.newscientist.com/blogs/culturelab/2010/08/learning-from-the-wisdom-of-herds.html?DCMP=NLC-nletter&nsref=wisdomofherds

Artificial ape man: How technology created humans
17:06 23 August 2010
Books

*Archaeologist and anthropologist **Timothy Taylor** explains how a long-vanished artefact explains human evolution and led to "survival of the weakest"*

Amanda Gefter, CultureLab editor

You begin your book *The Artificial Ape* by claiming that Darwin was wrong. In what way?

Darwin is one of my heroes, but I believe he was wrong in seeing human evolution as a result of the same processes that account for other evolution in the biological world - especially when it comes to the size of our cranium.

Darwin had to put large cranial size down to sexual selection, arguing that women found brainy men sexy. But biomechanical factors make this untenable. I call this the smart biped paradox: once you are an upright ape, all natural selection pressures should be in favour of retaining a small cranium. That's because walking upright means having a narrower pelvis, capping babies' head size, and a shorter digestive tract, making it harder to support big, energy-hungry brains. Clearly our big brains did evolve, but I think Darwin had the

wrong mechanism. I believe it was technology. We were never fully biological entities. We are and always have been artificial apes.

So you are saying that technology came before humans?

The archaeological record shows chipped stone tool technologies earlier than 2.5 million years ago. That's the smoking gun. The oldest fossil specimen of the genus *Homo* is at most 2.2 million years old. That's a gap of more than 300,000 years - more than the total length of time that *Homo sapiens* has been on the planet. This suggests that earlier hominins called australopithecines were responsible for the stone tools.

Is it possible that we just don't have a genus *Homo* fossil, but they really were around?

Some researchers are holding out for an earlier specimen of genus *Homo*. I'm trying to free us to think that we had stone tools first and that those tools created a significant part of our intelligence. The tools *caused* the genus *Homo* to emerge.

How do we know the chipped stones were used as tools?

If you wanted to kill something or to defend yourself, you don't need a chipped stone tool - you can just pick up a rock and throw it. With chipped stone, something else is going on, something called "entailment": using one thing to make another. You're using some object to chip the stone into a particular shape with the intention of using it for something else. There's an operational chain - one tool entails another.

What were these tools used for?

Upright female hominins walking the savannah had a real problem: their babies couldn't cling to them the way a chimp baby could cling to its mother. Carrying an infant would have been the highest drain on energy for a hominin female - higher than lactation. So what did they do? I believe they figured out how to carry their newborns using a loop of animal tissue. Evidence of the slings hasn't survived, but in the same way that we infer lungs and organs from the bones of fossils that survive, it is from the stone tools that we can infer the bits that don't last: things made from sinew, wood, leather and grasses.

How did the slings shape our evolution?

Once you have slings to carry babies, you have broken a glass ceiling - it doesn't matter whether the infant is helpless for a day, a month or a year. You can have ever more helpless young and that, as far as I can see, is how encephalisation took place in the genus *Homo*. We used technology to turn ourselves into kangaroos. Our children are born more and more underdeveloped because they can continue to develop outside the womb - they become an extra-uterine fetus in the sling. This means their heads can continue to grow after birth, solving the smart biped paradox. In that sense technology comes before the ascent to *Homo*. Our brain expansion only really took off half a million years after the first stone tools. And they continued to develop within an increasingly technological environment.

You write in the book that this led to a "survival of the weakest". What does this mean?

Technology allows us to accumulate biological deficits: we lost our sharp fingernails because we had cutting tools, we lost our heavy jaw musculature thanks to stone tools. These changes reduced our basic aggression,

increased manual dexterity and made males and females more similar. Biological deficits continue today. For example, modern human eyesight is on average worse than that of humans 10,000 years ago.

Unlike other animals, we don't adapt to environments - we adapt environments to us. We just passed a point where more people on the planet live in cities than not. We are extended through our technology. We now know that Neanderthals were symbolic thinkers, probably made art, had exquisite tools and bigger brains. Does that mean they were smarter?

Evidence shows that over the last 30,000 years there has been an overall decrease in brain size and the trend seems to be continuing. That's because we can outsource our intelligence. I don't need to remember as much as a Neanderthal because I have a computer. I don't need such a dangerous and expensive-to-maintain biology any more. I would argue that humans are going to continue to get less biologically intelligent.

If you said to me, you can either have your toes cut off or your whole library destroyed, with no chance of ever accessing those works again, I'd say "take my toes" - because I can more easily compensate for that loss. Of course, you could get into a grisly argument over how much of my biology I'd give up before I'd say, "OK, take the Goethe!"

Is human technology really any different from, say, a bird's nest, a spider's web or a beaver's dam?

Some biologists argue that human culture and technology is simply an extension of biological behaviours and in that sense humans are like hermit crabs or spiders. That's an idea known as "niche adaptation". I see human technology as different because of the notion of entailment. A number of philosophers and social anthropologists have argued that the realm of artifice has its own logic - an idea that traces back to Kant's idea of the autonomy of the aesthetic realm. Philosophy, art history and paleoanthropology have to all come together for us to understand who we are.

The point is, the realm of artificial things - that is, technology - has a different generative pattern than the Darwinian pattern of descent with modification. People like to argue that you can apply Darwinian selection to, say, industrial design. That led Richard Dawkins to propose and Susan Blackmore to develop the "meme" idea - cultural analogues of genes that are not biological but they are still replicators and follow the basic logic of biological evolution.

I would argue that memes simply don't make sense. And the reason is that when you look at an artificial object like a chair, for instance, there is no central rule that defines it. There is no way to draw a definite philosophical boundary and say, here are the characteristics that are both necessary and sufficient to define a chair. The chair's meaning is linguistic and symbolic - a chair is a chair because we intend for it to be a chair and we use it in a particular way. Artificial objects are defined in terms of intention and entailment - and that makes artificial things very different from biological things.

People like Ray Kurzweil talk about an impending singularity, when technology will advance at such a rapid pace that it will become intelligent and the world will become qualitatively different. Do you agree?

I am sympathetic to Kurzweil's idea because he is saying that intelligence is becoming technological and I'm saying, that's how it's been from the start. That's what it is to be human. And in that sense, there's nothing

scary in his vision of artificial intelligence. I don't see any sign of intentionality in machine intelligence now. I'm not saying it will never happen, but I think it's a lot further away than Kurzweil says.

Will computers eventually be able to develop their own computers that are even smarter than them, creating a sudden acceleration that leaves the biological behind and leaves us as a kind of pond scum while the robots take over? That scenario implies a sharp division between humans and our technology, and I don't think such a division exists. Humans are artificial apes - we are biology plus technology. We are the first creatures to exist in that nexus, not purely Darwinian entities. Kurzweil says that the technological realm cannot be reduced to the biological, so there we agree.

At the end of the book, you note that there is no "back to nature" solution to climate change. Does that mean our species was doomed from the start?

The point is, we were never fully biological entities, so there is no "nature" to go back to, for us. Wait, you might ask, what about people who "live in nature", people like the Aborigines in Tasmania? In fact, the Tasmanians used technology to adapt and survive and they might have done that for maybe another 40,000 years. The issue is that their type of technology - non-entailed - is not the way humans will survive in the final scenario. Ultimately we need major progress - because even without climate change, the sun is eventually going to blow up.

Now, you might think that's a ridiculously long time away, but that's the kind of ridiculous timescale palaeoanthropologists think about. I look back 4 million years and see our emergence and our evolution and then I look forward 4 million years because those are the timescales I'm used to. And in the long run, humans will go extinct if we can't get off this planet. The only way out, ultimately, is up. The Tasmanians didn't have the kind of technology that would lead them there, but we do.

Profile

Timothy Taylor is an archaeologist and anthropologist at the University of Bradford, UK. His book *The Artificial Ape: How technology changed the course of human evolution* is published by Palgrave Macmillan this month

(Image: Becca Wright)

http://www.newscientist.com/blogs/culturelab/2010/08/artificial-ape-man-how-technology-created-humans.html?DCMP=NLC-nletter&nsref=artificialapeman