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Training the Education Legislators

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PINEHURST, N.C. -- Legislatures in the vast majority of states will convene this month, and after an election cycle in which voters frequently favored newcomers over incumbents, public college officials and others will find an unprecedented number of unfamiliar faces among their local lawmakers. That turnover will almost certainly exacerbate the sense shared by many -- including a national group of state legislators themselves, in a 2006 report -- that legislative understanding of, and leadership on, higher education issues is lacking.

North Carolina's General Assembly convenes next week, and new legislators will fill the House and Senate chambers here as elsewhere. But thanks to a unique program aimed at enhancing the education expertise of lawmakers in the Tar Heel State, North Carolina's House and Senate members will start their session fresh off a crash course on the challenges facing the state's prestigious public college system.

Several dozen legislators spent two days last week at the 8th annual legislators' retreat sponsored by the James B. Hunt, Jr. Institute for Educational Leadership and Policy, where they heard presentations from national experts on a wide range of higher education issues and talked pointedly, in what several of them referred to as a "safe haven" out of the public spotlight, about the challenges ahead for North Carolina's higher education system.

"Legislators spend most of their time in session reacting," said State Representative Rick Glazier, a five-term Democrat and lawyer who teaches law at Campbell University. "This allows us to form some relationships and have the kind of discussions around the major issues that you don't always have the time to have when you're in session."

Creating 'Education Legislators'

That is exactly the goal of the retreat and of the institute named for Jim Hunt, who, in a total of 16 years in two stints as North Carolina's top public official, was widely hailed as the country's leading (if not first) "education governor."

Since its founding in 2002, much of the institute's work has focused on encouraging other governors to put education at or near the top of their agendas, but the center's leaders knew that governors could not make significant progress without the help of mayors, business leaders and others -- especially legislators.

So Hunt and his predecessor, former Gov. James Holshouser, a Republican, invited the Republican and Democratic leaders of the key education and financial committees to the first retreat in 2003, says Judith Rizzo, the institute's executive director and CEO.

The meeting was well-received -- so much so that other legislators wanted in. "What are we, chopped liver?" Rizzo recalls the rank-and-file lawmakers asking. The institute extended invitations the next year to all 170 members of the General Assembly, and the number of participants has climbed steadily over the years.

This year, for the first time, the main focus of the retreat shifted to higher education instead of K-12. The Hunt Institute's leaders hold a lunch each fall to solicit ideas from several legislators about what to cover during the retreat, and at last fall's lunch, postsecondary issues rose to the surface, with legislators eager to discuss the implications for North Carolina of President Obama's college completion agenda, as well as the almost certain need to cut higher education spending in what promises to be a budget-constrained 2011-12 legislative session.

More than 70 legislators -- including many brand-new members of the General Assembly -- had committed to attending the higher education retreat, though a snowstorm (and the winter-weather-related skittishness common in the South) suppressed the number who actually showed.

The several dozen hardy souls who made it brainstormed with national experts like Ohio Chancellor Eric Fingerhut and representatives of the Southern Regional Education Board and Georgetown University's Center on Education and the Workforce, as well as presidents of North Carolina public colleges and universities, including Guilford Technical Community College and North Carolina Central University, who shared ideas about programs they have developed that could be spread to other campuses.

The legislators also got occasional pep talks from Hunt, who exhorted them, as they prepare for a legislative session that is almost certain to require significant cuts in state funding, to do their best to protect education -- "the most important thing we do," as he described it.

Hunt has never hidden the fact that he is a believer in the power of education of all sorts, and the legislators at the retreat certainly had to know that they were hearing about the issues from the perspective of an advocate.

But while the retreat was very much *about* higher education, in terms of the material covered and the issues explored, it never had the feel of being presented from the perspective of colleges and universities -- a fact essential to its credibility, several lawmakers and others acknowledged.

"It couldn't be us doing it," said Thomas W. Ross, who was a full six days into his presidency of the University of North Carolina System when he participated in the retreat last week. "If [North Carolina's colleges and universities] tried to put something like this on, the legislators wouldn't come, or if they came, they would view it very differently," and more skeptically, he said.

"We try to be as honest brokers of information as possible," said Rizzo, the Hunt Institute's director. "We are in a unique position in terms of our ability to do that, given who we are as individuals. We love public education, but we also acknowledge, damn it, it's flawed."

The content of the retreat tilted toward the positive, with many of the speakers (in addition to Hunt) stressing the importance of education and higher education to the state's future and urging the legislators to give colleges more regulatory flexibility since they'll be unable to shield them from budget cuts. But speakers also cited data showing North Carolina trailing the national averages on such measures as the percentage of adults with a bachelor's degree or higher.

The balance in the program meant that even legislators who often take a skeptical view of higher education found value in the retreat. Dale R. Folwell, who describes himself as one of North Carolina's most conservative lawmaker and spoke frequently about the need for more accountability in education, answered a reporter's question about whether the retreat was helpful by recounting "what I tell my kids about how you learn: 'If you know what you don't know, and surround yourself with people who are smarter than you and who you don't agree with, you're going to end up better off.'"

A Model for Others

Just how uniquely positioned the Hunt Institute is to try to inform and influence state lawmakers about education may well be tested if, as seems likely, others consider adopting its model of the legislators' retreat.

The head of former U.S. Sen. Bill Frist's State Collaborative on Reforming Education, a Tennessee nonprofit group, attended the North Carolina seminar, and officials from several other states have asked the Hunt Institute for information about how they might put in place their own versions of the retreat.

The North Carolina retreat may be tough to replicate, given North Carolina's history of emphasis and bipartisanship on education (and higher education) issues.

"Not every place has a Jim Hunt and a Jim Holshouser," said R. Scott Ralls, president of the North Carolina Community College System, who also participated in last week's retreat.

Still, he said, "I can't help but believe that in every state, there are folks like these -- legislators who care about education, and leaders, regardless of party, who want to help them understand the issues."

— Doug Lederman

http://www.insidehighered.com/news/2011/01/18/program_informs_north_carolina_legislators_about_higher_education

Affirmative Action Bans: Who Gets Hurt

Blacks and Latinos who apply to the most selective public universities in some 'race-blind' states are being reshuffled downward to lower-quality schools, researchers say.

By Melinda Burns

Blacks and Latinos in 'race-blind' states are being reshuffled downward to lower-quality schools, researchers say. (Sportstock / istockphoto.com)

If the experience of California and Texas is any guide, this is what a state might expect if it bans the use of racial preferences in college admissions:

Everyone who wants to go to college, including blacks and Latinos, will get into college – somewhere. But many more blacks and Latinos will be turned away from the best universities and left to "cascade down" to less selective four-year schools or two-year community colleges. Elite universities will become more white and Asian.

In November, Arizona became the eighth state in the country to ban affirmative action in public higher education, following the lead of California, Florida, Georgia, Michigan, Nebraska, Texas and Washington. *The Arizona Republic* said affirmative action was "no longer needed." Yet a large body of research shows how and why the "race-blind" admissions at flagship universities in states with bans dramatically fails to keep pace with changing demographics, even as the population of minority high school students overtakes that of whites.

Take the case of California, as reported in *Equal Opportunity in Higher Education*, a new book on the state's voter-approved ban on affirmative action known as Proposition 209. In 1994, four years before the measure went into effect, when colleges were giving a boost to applicants based on race, 38 percent of high school graduates and 18 percent of University of California students were African American, Latino or Native American. In 2008, after a decade with the ban, these minorities represented nearly half of high school graduates but only 20 percent of UC students.

"By stepping back from its commitment to affirmative action, we believe California and other states and colleges have contributed to an increase in racial and ethnic stratification," wrote co-editors Eric Grodsky, a sociologist at the University of Wisconsin-Madison, and, Michal Kurlaender, a professor of education at the University of California, Davis. "Within college types, [underrepresented minority] students tended to shift from higher- to lower-quality colleges and universities. … African American and Latino undergraduates in the state of California may be worse off now than they were 10 years ago."

Two new studies from the Georgetown Public Policy Institute — the first to compare states with and without affirmative action bans and before and after they went into effect — suggest just how big the impact may be at the most selective schools.

Taking a broad look at college enrollment and racial composition across the country between 1995 and 2003, economist Peter Hinrichs found that affirmative action bans have no effect on the typical four-year college or the typical student. But at public universities in the top 50 of the *U.S. News & World Report* rankings, he found, the numbers of blacks and Latinos typically drop 30 percent and 27 percent, respectively, after affirmative action bans are imposed, compared to pre-ban enrollments, while the numbers of whites and Asian Americans increase 5 percent to 6 percent.

Over a broader range — the top 115 public and private colleges in the U.S. News rankings — the numbers of black and Latino students drop 17 percent and 16 percent, respectively, at schools with affirmative action bans, Hinrichs found.

Separately, Hinrichs showed that the numbers of black and Latino graduates from the top universities also decline at selective schools with affirmative action bans, a direct consequence of declining minority enrollment.

The opponents of affirmative action have argued that many students of color are better off at less selective schools because, coming from poor backgrounds and mediocre high schools, they may be less well prepared for the academic rigors of college than their more affluent white peers. But researchers have found little evidence that blacks and Latinos do worse at the most selective schools and some evidence that they perform better than the whites they replace.

A 2010 study co-authored by Marta Tienda, a Princeton University sociologist, showed that black and Latino students who were admitted to the University of Texas at Austin on the basis of their high school rankings consistently got as good or better grades in college than the affluent whites with higher SAT scores whom they replaced. The minority students also were equally or more likely to graduate in four years.

The Texas experiment suggests that universities seeking to diversify their campuses will be better served if they emphasize high school grades over standardized tests, Tienda said.

"Test scores are not a strong predictor of success," she said. "I say, let's reward merit. Our schools are highly unequal. But the high-performing kids in the low-performing high schools are actually doing well in college. It's driven by their motivation. They make the most of what their schools have to offer."

The less selective public universities in Texas have benefited from the "cascading down" of lower-ranked white and minority students — those in the top 20 or 30 percent of their high school classes. In a study of seven public colleges in Texas, Tienda and Mark Long, a co-author and the associate professor of public affairs at the University of Washington, showed how these students have improved the average SAT scores of students at less selective schools. Before affirmative action was banned, many of them had been accepted into the flagship schools.

But the students themselves may not have benefited from being reshuffled. New research shows that the freshmen retention rates and six-year graduation rates of lower-ranked minority students have declined by 2 to 5 percent in Texas' less selective colleges.

To address the widening gap between whites and minorities in higher education, California and Texas implemented policies to boost enrollments for high school students in the top 4 percent and 10 percent of their graduating classes, respectively. But these policies have been arguably as controversial as the systems they replaced. They have not nearly recovered the diversity that was lost after the affirmative action bans went into effect.

When then-Gov. George W. Bush signed into the law the Top Ten Percent plan in 1997, he said, "We want our universities to reach out to students from all walks of life, and this legislation gives them the flexibility to do just that." Don Brown, then-Deputy Commissioner of the Texas Higher Education Coordinating Board, told the Texas State Senate that the legislation would "increase the pool, the diversity of the pool of students that's available to institutions in Texas, particularly the most selective institutions."

In reality, the plan has catapulted students from high schools in rural areas and small towns into the flagship universities, dramatically broadening geographic representation at UT Austin and Texas A&M University, as Long and Tienda showed in a study of 1,800 high schools in the state. But when it comes to diversity, the ban on affirmative action in Texas has had a chilling effect. Comparing application rates before and after the Top Ten Percent plan, Tienda and Angel Harris, another Princeton sociologist, estimate that the state's flagships are losing nearly 7,000 potential black and Latino applicants annually.

According to Long, racial diversity would not hypothetically rebound by more than 25 percent anywhere in the country under a Texas-style Top Ten Percent plan. There are simply not enough blacks or Latinos at the top of their high school rankings in any state in America to substantially improve their share in most selective colleges under that scenario.

"You think you're going to get a community that looks like the state as a whole," he said. "But the top 10 percent is heavily skewed toward Asian students. There is no true substitute for affirmative action. Nothing proxies for race like race."

There are unintended consequences, too. One study shows that some college-educated parents in Texas are moving their families to areas with low-performing high schools so that their teens can be in the top 10 percent of their class. Along these lines, another study co-authored by Long and published this month by the National Bureau of Economic Research reports that a number of students between eighth and 10th grades, including minorities, are "trading down" to previously undesirable high schools to improve their class rankings. The net effect of these strategic transfers is to push out other minority students in the top 10 percent of the chosen high schools and slightly increase the representation of whites, the researchers found.

Many studies show that racial and ethnic diversity in the classroom fosters democratic values and helps promote critical thinking because all students are exposed to new perspectives and experiences. In Equal Opportunity, Susan Wilbur, the director of UC admissions, describes how many of the top Latino applicants to UC schools and especially the top black applicants are choosing instead to attend top-tier private colleges because of California's affirmative action ban. More than half of the top black applicants and 30 percent of the top Latino applicants admitted to a UC campus in 2005 opted to attend a selective private college instead, Wilbur said, compared to 15 percent of Asians and 19 percent of whites.

"While this behavior is not entirely unexpected, it nevertheless represents a significant loss of talent to the University of California, and it can be argued that students who do choose to attend UC are poorer for the loss of these talented youth," she wrote.

According to Hinrichs, there was a slight rebound in diversity at the UC campuses a few years after the ban went into effect — the likely result, he said, of outreach policies, scholarships and the decision to boost enrollment for the top 4 percent of high school graduates. But the share of black and Latino students remains well below pre-ban levels, especially in the top schools.

The UC Academic Senate noted last year that the "constraints of Proposition 209 have consistently limited UC's capacity to significantly increase the representation of African-American students," and "the representation of Chicano/Latinos has been substantially less than their representation in high school graduating classes."

Beginning in 2012, the top 9 percent of high school graduates in California will get a boost in applying to UC schools, or more than double the current 4 percent. Equal Opportunity offers a number of other ways to improve diversity in higher education, starting with revamping the under-funded, overcrowded and poorly staffed high schools where black and Latino students make up the majority.

In addition, SAT scores could be made optional for college admission as a way of leveling the playing field, and they could be replaced by high school grades, the authors said. In place of the SAT, students could take a state test geared to state standards for each subject. More students could be encouraged to transfer from community colleges to UC schools. Or the state could emphasize native languages or neighborhood demographics in college admissions.

The U.S. Supreme Court has ruled out affirmative action if it is mechanically applied with quotas, but the court has said that "a narrowly tailored consideration of race in admissions decisions" is legal.

"In terms of the original goal," Tienda wrote in Equal Opportunity, "… there is growing agreement that narrowly tailored racial preferences are a much more efficient way to achieve racial or ethnic diversity than top X percent plans."

http://www.miller-mccune.com/education/affirmative-action-bans-who-gets-hurt-26955/?utm_source=Newsletter144&utm_medium=email&utm_content=0118&utm_campaign=newsletters#

Your Next M.D. Might Be a PDA

Handheld sensors using specialized — and relatively cheap — biosensors may deliver an instant diagnosis of diseases, contaminated water and biological attacks.

By Michael Haederle

Your doctor has a hunch that your respiratory infection and fever are caused by bacteria (and should be treated with antibiotics), but it might instead be a simple virus, which should be allowed to run its course.

Today, lab tests could take several days to complete, but in a couple of years a handheld device called an acoustic wave biosensor might sample a droplet of your saliva to reveal within seconds whether your doctor's hunch was correct.

Just three of these biosensors, developed by the University of New Mexico Health Sciences Center and Sandia National Laboratories, exist at the moment. But the invention has been licensed for development, garnering enough buzz to have made *R&D Magazine*'s Top 100 list for 2010.

"It tells you in five seconds to two minutes whether or not there's an infection there and what type it is," says Dr. Richard Larson, vice president for research at the UNM health center and the sensor's lead inventor.

Such devices could transform the practice of clinical medicine, but they could also be useful for screening blood, checking for water contamination and identifying veterinary diseases, he says.

"We have shown that it works with a whole variety of different viruses. We can detect H1N1. We can detect HIV. We can detect hepatitis B and hepatitis C, and a whole variety of bad viruses that could be used by terrorists."

The device holds a slot for a removable dime-sized chip. Each chip, which can be manufactured for under $10 apiece, is customized to detect one of a variety of viruses and bacteria by coating a tiny electrode made from lithium tantalate with a peptide — a short polymer made of amino acids — specific to that microbe. If the suspect germ is present in a drop of urine, blood or saliva sample, it will bind with the peptide.

"It's like a microscale," Larson says. "It can measure the weight of a virus. So when a virus gets specifically caught on the surface of the chip by the molecule, that weight causes a sound wave to form on the chip — that's the electronic part."

The idea originated while Larson was exploring ways to rapidly screen new drugs, but he shifted directions when someone mailed anthrax-laden envelopes that killed five people and injured more than a dozen others in the wake of the 9/11 attacks.

"After 9/11 we thought we could build a technology for first responders, so if they went into a disaster situation and there was a white powder, they would be able to rapidly test it for anthrax," Larson says.

"In order to get this to work, the real key was to get a set of engineers and physicists to work with a bunch of biologists and chemists."

UNM scientists worked on developing the microbe-specific peptide coatings, while the Sandia team perfected the acoustic-wave chip technology — all with substantial funding from the Defense Intelligence Agency.

The chips are so sensitive they need only 30 viral particles to set off a signal, Larson said. Any water-based bodily fluid can be injected into the sensor's port, he says, but suspect dry powders would first have to be mixed into a water solution to be tested.

As the defense-oriented version of the device came together, Larson says, "We decided we should apply this to medical use where it could have a broader impact and changed the platform of the sensor so we could detect viruses and bacteria that were relevant to human infection."

One obvious application was for disaster scenarios, such as Haiti in the wake of the devastating earthquake there earlier last year, Larson said. The portable device, powered by AA batteries, could readily detect whether blood from a prospective donor was free from HIV or hepatitis-causing viruses, he says.

Provisional patents have been filed and the device has been submitted to the FDA for approval. Meanwhile, UNM has licensed the technology to Adaptive Methods, a Centreville, Va.-based firm that specializes in sensor technology, to bring the biosensor to market. Adaptive Methods said in a news release that it plans to commercialize the technology for use in the healthcare, homeland defense and military sectors.

Larson predicts the biggest market for the devices will be in medical practices where rapid infection diagnosis is important, including those specializing in respiratory infections and sexually transmitted diseases.

The one limitation of the device is that it cannot detect whether a microbe is from a drug-resistant strain — traditional lab cultures will still be required for that. Meanwhile, he envisions a future where different medical specialists would keep a unique selection of chips on hand suited to their type of practice.

Larson's biggest headache at the moment is in sorting through the multitude of potential uses to figure out which one to focus on. "We'll put our effort where we can have the biggest impact," he says.

http://www.miller-mccune.com/health/your-next-m-d-might-be-a-pda-26777/

Neuroscience: Is it All in Your Mind?

Although it's fun and science-y to know how the physical brain parses data, most of us really should be more interested in what the mind is doing.

By Nate Kornell and Sam Kornell

The media's fascination with brain science is obscuring what's really important — the mind. (mstroz / istockphoto.com)

"Brain's God Spot Discovered By Scientists."

That's the headline the Huffington Post ran with after a team of neuroscientists discovered that profound religious and spiritual experiences light up discrete portions of the brain. That the media termed these chunks of mystical gray matter the "God Spot" was both clever and predictable; thus reduced, the research became instantly famous and immediately controversial: People didn't want to see their deepest beliefs reduced to a simple biological explanation.

Neuroscientists are now able to use sophisticated technology to peer into the skull and study the brain in unprecedented ways, and the boom in neuroscience research over the past decade has captured the public's imagination. But some scientists are worried that the public's imagination, fueled by simplistic media reporting, has run away with itself.

In a newly published article in the journal of *Perspectives on Psychological Science*, Diane Beck, a professor of psychology at the University of Illinois, argues that the allure of many neuroscience studies is that they can be made to offer "deceptively simple messages" about human behavior. She also says that their popularity is partly based on a "sometimes misguided confidence in biological data."

Articles trumpeting new neuroscience research have become a reliably popular subject for newspapers and magazines. They might be called There's a brain area for that?! stories. Typically, a headline will advertise, implicitly or explicitly, an "objective" new explanation for some common form of human behavior. Underneath the headline, however, the startling information the reader has been promised turns out to be not so startling. We "commonly see statements such as 'Chocoholics really do have chocolate on the brain,''' Beck writes. "Do people really doubt that chocoholics love chocolate? … This is probably something most people already believe without the need for a corroborating brain scan."

Likewise, that spiritual feelings can be localized to specific parts of the brain is important to neuroscientists. But how important is it to you? Put another way, is it really surprising that religious and spiritual feelings occur in the brain? It shouldn't be: If it was the spirit that moved you, the spirit can still do it in a way that affects your brain.

There's a brain area for that?! stories can also be misleading, either because of flaky science or careless reporting, or both.

Last fall, a brain imaging study out of Syracuse University produced the memorable headline "Brain Takes Less Than Second To Fall In Love." That's not a typo. A 2007, pre-election article in *The New York Times* reported on 20 people who had their brains scanned while viewing photographs and videos of the major presidential candidates.

"It was really closer to astrology than it was to real science," Russell Poldrack, director of the Imaging Research Center and professor of psychology and neurobiology at the University of Austin, later told *Science*. "It epitomized everything that a lot of us feel is wrong about where certain parts of the field are going, which is throw someone in a scanner and tell a story about it."

Even when an article about neuroscience is a carefully reported account of a valuable study, confusion remains about to whom the study is actually valuable. If a study reports that religious feelings occur in the brain, most people wouldn't care if they occur in the temporal lobe instead of the parietal lobe and for good reason: They aren't neuroscientists.

So why do readers seem to find articles about neuroscience more fascinating and convincing than studies that examine behavior without biology? One explanation is that people can connect what they learn in a neuroscience study to visual images of the brain.

Recently researchers at Colorado State and UCLA asked a group of undergraduate students to assess the following (spurious) argument: "Because watching television and completing arithmetic problems both lead to activation in the temporal lobe, watching television improves math skills."

There were two groups of subjects; for one, the argument was accompanied an uninformative bar graph, and for the other an uninformative brain scan. The brain scan offered no new or relevant information — it was just a picture of a brain with some colors superimposed. Yet participants who saw the brain scan rated the argument as more convincing.

"Part of the fascination, and the credibility, of brain imaging research lies in the persuasive power of the actual brain images themselves," the researchers concluded.

There is also evidence suggesting that people are impressed by the language of neuroscience itself, even as its references to Latinate sections of the brain can be difficult to understand. It seems science-y in a way that calls to mind biology and physics. There may be other reasons too.

What seems certain is that people want certainty, and they believe that neuroscience provides them with a kind of certainty that social sciences do not.

This faith in neuroscience over social science can have consequences. Does a teacher need to know what neurotransmitters are involved in spelling, for example? Or what brain areas are involved in learning times tables? Not really.

Scientific evidence can be used to guide the teacher. But the key science is the science of the mind, not the science of the brain. What the teacher needs is good old-fashioned studies that compare different approaches to learning, using randomized samples, measuring long-term outcomes and suggesting pedagogical approaches the teacher can actually implement. Yet educators who are making consequential decisions may pay attention to brain-based studies even if other studies would be more appropriate.

An imperfect analogy can be made to computers. Brains are a bit like hardware (e.g., microprocessors, hard disks, etc), and minds are something like software. The circuits do control the software. But if you want to figure out how to use your computer to do your taxes, you should look for tax software. The last thing you should do is open up your computer and start digging through silicon looking at circuits.

If there is a large gap between computer hardware and software, there is a giant chasm between the science of the brain and the science of the mind. Neuroscientists are starting to build bridges, but the gap remains, something most neuroscientists would hasten to concede.

In the media, though, you get the impression that the gap barely exists at all. This impression can be admittedly enjoyable. Who can pass up an article about the brain's "love center"? Maybe it will finally explain why life is a war between men and women. But we would learn more by examining the warriors' minds than by looking at their brains.

http://www.miller-mccune.com/media/neuroscience-is-it-all-in-your-mind-26792/

Movie cigarettes make smokers mentally 'light up'

22:00 18 January 2011 by **Andy Coghlan**

No wonder it's so difficult to kick the habit: smokers who watch movie stars light up cigarettes on screen simultaneously activate the parts of the brain needed for the same task.

Previous studies have shown that watching screen smoking activates parts of the brain involved in craving and reward, but the new research is the first to show that priming for the physical act of lighting up becomes automatic too.

"What's particularly novel about these findings is that viewing movie smoking activated regions involved in understanding and planning actions," says lead author Dylan Wagner of Dartmouth College in Hanover, New Hampshire.

Wagner used an fMRI to scan the brain of 17 smokers and an equal number of non-smokers while they viewed scenes from the film *Matchstick Men*, which included several clips of actors lighting up. The volunteers were unaware that their reactions to smoking were being analysed.

Only in smokers did Wagner see activation of parts of the brain vital for goal-directed hand actions, including the anterior intraparietal sulcus and the lateral inferior frontal gyrus. "Moreover, we found that activity in these regions tracked with the hand the smokers use for smoking," he says.

Tobacco training

The findings dovetail neatly with the earlier work showing that smokers had increased cravings to smoke after they'd watched movies in which actors had done so.

"I believe people should simply be aware that exposing themselves to subtle cues of smoking, like those in a movie, may have an influence on their desire to smoke, but the first step in thwarting this is knowing about it," says Wagner.

"From kids starting to smoke to adults struggling to stop, the tobacco industry benefits hugely from smoking on screen," says Stanton Glantz of the University of California, San Francisco.

"This new study connects the biology to the behaviour, and is a big step forward in our understanding. The question is whether the motion picture industry will keep doing big tobacco's dirty work."

A study in 2003 showed that the movie industry was the biggest factor prompting adolescents to begin smoking. And in 2008, a study revealed that tobacco companies in the 1950s had secretly paid big stars including Clark Gable to promote their products.

Journal reference: *Journal of Neuroscience*, DOI: 10.1523/jneurosci.5174-10.2011

http://www.newscientist.com/article/dn19980-movie-cigarettes-make-smokers-mentally-light-up.html?full=true&print=true

Rise of the robot astronomers

- 18 January 2011 by **Anil Ananthaswamy**
- Magazine issue 2795.

Who will analyse the images? (Image: Roger Ressmeyer/Corbis)

Long nights spent peering into the cosmos are over, for humans at least. Artificial intelligence will take charge of the planet's greatest telescopes

IN October 1923, after nights of meticulous observations with the 100-inch telescope on Mount Wilson near Pasadena, California, Edwin Hubble noticed three new specks of light in one photograph of the Andromeda nebula that he marked with N for nova.

Hubble's specks were the first step towards his discovery that the universe was expanding. When he compared his Andromeda photograph with earlier images, he crossed out one N and wrote VAR! next to it. It was not a nova but a variable star, whose brightness fluctuates in a manner that allowed him to measure how fast it was receding from Earth.

Such a romantic tale of a lone astronomer unlocking the secrets of the universe is unlikely to be repeated. Robot astronomers are increasingly scouring the skies in place of humans, cataloguing stars and galaxies as well as making the observations that could help solve the puzzle of dark energy, the stuff we think is accelerating the expansion of the universe.

Robotic telescopes are making observations that could solve the puzzle of dark energy

At the Mount Palomar Observatory, about 150 kilometres south-east of Hubble's workplace, the Palomar Transient Factory (PTF) has artificial intelligence to help it find "transients" - variable stars and short-lived celestial objects such as supernovae.

The Palomar Transient Factory looks for short-lived objects and can spot a supernova in real time

Computers analyse images, identifying interesting transients so that the robot telescopes can follow them before they disappear from the night sky. "Our grand goal is to remove astronomers from the real-time loop of

looking at images and doing discovery of astronomical transients," says team member Joshua Bloom of the University of California, Berkeley. This will allow humans to focus on the theoretical ramifications of what the automatons find.

Why is such a change necessary? Telescopes can dwarf large office buildings in size and they are getting bigger, drowning astronomers in a deluge of data. Consider the Large Synoptic Survey Telescope (LSST), an 8.4-metre telescope being built atop Cerro Pachón in Chile. Every night, its 3200-megapixel camera is expected to find 100,000 transients. "There are not enough graduate students in the world to follow up all these things," says astronomer Kirk Borne of George Mason University in Fairfax, Virginia.

Astronomers hope AI and automation will come to the rescue. The neural network, software that mimics networks of neurons in the brain, was one of the first AI techniques employed in astronomy. Neural networks have been trained to analyse astronomical images and distinguish the point sources of light that are stars from the more diffuse light of galaxies.

Now more sophisticated AI techniques are being added to the mix. The astrometry.net project, for example, uses machine-learning algorithms to help astronomers tag any image of the sky with precise coordinates. The software is trained by analysing existing star catalogues and creating sets of four stars, each of which serves as a three-dimensional reference for some part of the sky. Given a new snapshot of the sky, the algorithms look for sets of four stars in the image and try and match them to those extracted from the star catalogues.

The trouble is, camera angles and scales can change from image to image. So the algorithms use a technique called geometric hashing to describe the geometry of any set of four stars in a way that does not depend on their relative positions or the camera angle. "In other words, no matter where you see those four stars, you'll still be able to recognise that shape," says team member Dustin Lang of Princeton University. "It's a little bit like our ability to recognise the constellations."

Machine-learning algorithms can also unearth outliers, odd objects such as quasars. In any given image of the sky, the majority of the point sources of light are stars. Maybe 1 in a 1000 is a quasar, an extremely distant but powerful galaxy. It is quasars that interest Borne. He starts with a set of parameters that define the pinpricks of light in an image - such as colour and brightness, among hundreds of other properties. The parameters of each object are compared with those of every other object in the image. Stars will have similar properties, but occasionally the object will be a quasar and its matrix will stand out brightly.

The system isn't foolproof, and sometimes the outlier is simply noise. To avoid such mistakes and to figure out whether something interesting really is lurking in that part of the sky, Borne's software taps into the Virtual Observatory - a massive collection of astronomical data sets spread around the world. Maybe, for example, another telescope identified the region as a radio source. The additional data allows the software to weed out spurious signals, and will help refine its predictions. The goal is to identify a source in the sky worth following up.

Examining images, and directing telescopes to follow up on objects of interest in real time, rather than weeks after as Borne's system does, is a much trickier prospect.

Over the past six months, the Palomar Transient Factory has automated this entire process. It starts with images collected by a 48-inch Schmidt telescope on Mount Palomar. Each night, computers pore over the images for transients. First, they take a reference image for a given part of the sky, which has been built up by combining multiple earlier images. This is aligned with and subtracted from the latest image to reveal any new objects in the sky. If the position of a new source has changed appreciably over days, for instance, it's likely to be an asteroid, not a variable star or a supernova, and is weeded out.

The system then searches other astronomical databases on the internet for additional information about that location in the sky, looking for a nearby X-ray source or data taken by different telescopes in other wavelengths. This information helps firm up the prediction of the nature of the mysterious object.

Supernovae need to be studied immediately, before they fade. So if the classifier is confident it has found one, two robotic telescopes will swing into action - the Peters Automated Infrared Imaging Telescope in Arizona and a 60-inch optical telescope on Mount Palomar. "Some of the slam-dunk things that we are already doing is finding and identifying type Ia supernovae weeks before their maximum light," says Bloom.

Every night, PTF is turning up 100 variable stars and five supernovae that have yet to reach their maximum brightness, all without the need for human astronomers. Catching supernovae before their peak brightness allows astronomers to tell their distances from Earth. They can then be used as "standard candles", to help

understand how the expansion of the universe has changed with time, which in turn will tell us about the nature of dark energy.
And Hubble's legacy might yet play a role in solving the mystery of dark energy. The famous Hubble Space Telescope is also robotic, and is routinely used to make follow-up observations of supernovae.

Social networking for telescopes

To automate astronomy you need a network of robotic telescopes, all talking to each other. The Las Cumbres Observatory Global Telescope Network, when complete, will link up robotic telescopes in Hawaii, Chile, Australia, South Africa, Texas and the Canary Islands. This will ensure that the sky will always be dark over at least one of the telescopes in the network, and observations can be passed automatically from one telescope to another.
Similarly, the Heterogeneous Telescope Network (HTN) consortium has developed a common software language for telescopes. It's being used by the eSTAR project, an intelligent robotic telescope network. For instance, the system links NASA's SWIFT satellite and the 3.8-metre United Kingdom Infrared Telescope (UKIRT) on Mauna Kea, Hawaii. If SWIFT spots a gamma-ray burst an alert is relayed instantly to UKIRT, which can perform follow-up observations. Observatories can choose to join the network as and when they please. It's a planet-spanning chatroom for telescopes.
Remote-controlled robotic telescopes are also ideal for regions that are hostile to astronomers but brilliant for astronomy. Telescopes are now being built on Dome C, 3260 metres up on the Antarctic Plateau and at the 4517-metre-high Hanle Observatory in the Indian Himalayas. The instrument at Hanle is part of an international collaboration called COSMOGRAIL (for Cosmological Monitoring of Gravitational Lenses), which uses a network of small telescopes to continually monitor the bending of light from quasars due to the gravity of a galaxy or cluster of galaxies in the line of sight.

http://www.newscientist.com/article/mg20927954.900-rise-of-the-robot-astronomers.html?full=true&print=true

Vacuum of space no match for the mighty radish

- 14 January 2011 by **David Shiga**
- Magazine issue 2795.

IMAGINE this: you are on an outpost on Mars, and the pressurised greenhouse that is supplying your food and oxygen springs a leak. As its precious contents are exposed to the harsh vacuum of space, starvation beckons. But all is not lost if the leak can be plugged in time. It seems some plants can survive half an hour in a near-vacuum.

Vacuum-like conditions are hostile to life both because they lack oxygen needed for respiration and because water, a component of many living things, boils quickly at low pressure.

To test how plants cope under these conditions, Raymond Wheeler of NASA's Kennedy Space Center in Florida and colleagues grew radish, lettuce, and wheat plants for 20 days in a chamber at normal atmospheric pressure. Then they pumped the air out, plunging the pressure to just 1.5 per cent of the average air pressure at sea level, for 30 minutes.

After the team returned the pressure to normal, all the plants continued to grow until being harvested a week later. The plants appeared to be just as healthy as another set of plants never exposed to low pressure, with no significant difference in weight (*Advances in Space Research*, DOI: 10.1016/j.asr.2010.12.017). Only a few other forms of life, such as bacteria, have shown such resilience.

Water evaporated from the leaves when the pressure was reduced, making them wilt temporarily. So Wheeler suspects dehydration, rather than a lack of oxygen, will ultimately kill plants exposed to a vacuum and hopes to test their breaking point in future experiments.

The plants appeared to be just as healthy as control plants that were never exposed to a vacuum

Fred Davies of Texas A&M University in College Station says this is the first experiment to test the effects of a sudden plunge into near-vacuum conditions.

"Plants are very plastic and resilient," he says.

http://www.newscientist.com/article/mg20927953.500-vacuum-of-space-no-match-for-the-mighty-radish.html

Winging it: NASA's aviation vision

17:30 18 January 2011
Technology
Paul Marks, senior technology correspondent

(Image: NASA)

Because it mainly talks about outer space, you could be forgiven for not knowing that the first 'A' in NASA actually stands for aeronautics - giving the National Aeronautics and Space Administration a role in shaping the future of American aviation. And in future, as we all know, aircraft are going to have to cut their greenhouse gas emissions, burn less fuel and lessen the noise nuisance to people who live near airports. So since October 2008, engineers at NASA's Fundamental Aeronautics Program in Langley, Virginia, have been considering ideas from industry and academia on how aircraft might offer these capabilities.
The NASA team has now given three firms the go-ahead to develop their ideas further. Stealth fighter maker Lockheed Martin's idea - above - is easily the most radical. It proposes a jetliner with a single engine (let's hope it doesn't flame out or suffer birdstrike) that extends the wing tip "winglets" over the top of the plane to form a horizontal stabiliser atop the tail fin. Winglets prevent eddy current drag at the wing tips wasting fuel - and this design seems to take that concept to the max. Me? Going from four engines to two on long haul is bad enough - one engine seems a step too far.

Next up is Boeing with this computer-stabilised version (above) of Jack Northrop's B35 Flying Wing. Without extraneous protuberances like a fuselage and a conventional tail fin/tailplane combination this is theoretically a hyper-aerodynamic option - with the whole plane providing lift. Back in the day, stability in turbulence was a problem - but latterday fly-by-wire computers, continually adjusting flight trim, should be able to cope with that. However, with the passengers all ensconced within the wing, those computers had better work and work well - or those way out at the far ends of the wing will be on a roller coaster ride.

Crucially, this design naturally blocks propellor or jet engine noise transmission to the ground - a result of its birth in MIT's Silent Aircraft Initiative.

(Image: NASA)

This last model (above) that NASA is funding further work on, from Northrop Grumman, is the most bizarre. The reason? Simply for the place they put the cockpit. Last November, oil leaked into an Airbus A380 engine causing a fire that led to it shedding a high-energy turbine rotor disk - which tore through the wing, fuel tanks and hydraulics. The A380's back-up systems saved the day and no-one was hurt - but the risks from an exploding engine are surely too high to place a cockpit smack between the engines?

Today's computerised planes are smart, sure, but we still like our pilots to stay in one piece. Perhaps that centre cabin could be a watch-the-clouds-go-by passenger-viewing gallery instead, leaving the pilots in the outer booms.

Whatever, it's fascinating to see NASA exploring how a raft of still developing technologies can best be harnessed to make flight ever more efficient - whether it's using shape memory alloys and carbon composites in morphing wings and winglets or even the low drag idea of virtual reality windows instead of what are effectively portholes.

(Image: Airbus)

Europe is not being left out here, by the way. The pan-European Airbus company, based in Toulouse, France, has advanced concept planes on the drawing board too - and like NASA's options (see above) they also combine extended drag-reducing winglets with a snug, quieter engine position - and lean-burn engines at that.

It all adds up to one thing: the skies are going to look very different come the middle of the century.

http://www.newscientist.com/blogs/shortsharpscience/2011/01/nasas-aviation-vision-wraparou.html

Road train technology can drive your car for you

- 17:06 18 January 2011 by **Duncan Graham-Rowe**
-

Letting drivers read a book, surf the net or possibly even have a snooze while behind the wheel may not sound like the best way to improve road safety. Yet that's precisely the aim of an automatic driving system that has just been road-tested for the first time in Sweden.

By linking cars together into road trains or "platoons" to form semi-autonomous convoys under the control of a professional lead driver, the hope is that average road speeds can be reduced, improving fuel consumption and cutting congestion.

In a test performed late last month, Volvo, one of the partners of the Safe Road Trains for the Environment (SARTRE) Project, showed that a single car could join a platoon, be "enslaved" by a lead truck, and then exit safely. Discussions are now under way to carry out tests on public roads in Spain next year.

Platooning is not a new idea, says Tom Robinson of engineering firm Ricardo UK in Cambridge, the co-ordinator of the project; it is funded by €6.4 million of European Commission money. Early small-scale tests, such as the PATH project tested in San Diego in 1991, used induction loops in the road, he says. "We are looking at operating platoons on public highways without having to change the infrastructure".

Your sensors are mine now

Some modern cars already come equipped with sensors and actuators to ensure that they don't get too close to the car in front, or don't drift out of their lane, says Robinson. SARTRE was set up to exploit these technologies, but to use them to bring vehicles closer together instead.

Using a wireless standard developed specifically for vehicle-to-vehicle communication – IEEE 802.11p – these systems would be enslaved by the lead vehicle, which would be either a truck or a coach. The car would be placed under the control of that lead vehicle, allowing the driver to take their hands off the wheel until they wish to leave the platoon.

To join a platoon, a car broadcasts its destination as it drives onto the freeway and a computer system tells the driver of any nearby platoons heading that way.

Each car is fitted with a navigation and communication system which measures the car's speed and direction, constantly adjusting them to keep the car within a set distance of the vehicle in front. All commands to steer or change speed come from the driver of the lead vehicle and are carried out automatically.

Would you trust it?

Both drivers and authorities will need some convincing that the system is safe and able to cope with unforeseen road hazards, says Andrew Howard, head of road safety at the Automobile Association in Basingstoke, UK. But, he says, it makes a lot of sense. Transport authorities always want to find ways for vehicles to travel more closely together while remaining safe, because it means you can cram more cars on the roads without having to build more lanes.

"If vehicles are driving a lot closer together and there's a lot less variation in vehicle speed, we believe it's likely to reduce congestion," says Robinson. And because the lead vehicle will have its speed limited, fuel consumption and carbon dioxide emissions will be reduced by up to 20 per cent, he says.

http://www.newscientist.com/article/dn19987-road-train-technology-can-drive-your-car-for-you.html?full=true&print=true

Cyberwar countermeasures a waste of money, says report

- 17:42 17 January 2011 by **Paul Marks**

When the writer of an infamous book for hackers says we should stop panicking about cyberwar it's probably time to sit up and take notice.

"Governments should take a calm, disciplined approach and evaluate the risks of each type of attack very carefully rather than be swayed by scare stories," says Peter Sommer of the London School of Economics. Under the pseudonym "Hugo Cornwall", Sommer published the infamous *Hacker's Handbook* in 1985. Since then he has become a noted security researcher and expert witness. Now he has co-authored a report for the Organisation for Economic Co-operation and Development (OECD) which warns governments against swallowing wholesale stories about "cyberwar" and "cyberweapons".

Published today, *Reducing Systemic Cybersecurity Risk* says that a true cyberwar would have the destructive effects of conventional war but be fought exclusively in cyberspace – and as such is a "highly unlikely" occurrence. Like others, *New Scientist* has often used the term.

Cyber-spying

"Analysis of cyber-security issues has been weakened by the lack of agreement on terminology and the use of exaggerated language," the report says. "Cyber-espionage is not a few keystrokes away from cyberwar, it is a method of spying."

Controversially, the OECD advises nations against adopting the Pentagon's idea of setting up a military division – as it has under the auspices of the US air force's Space Command – to fight cyber-security threats. While vested interests may want to see taxpayers' money spent on such ventures, says Sommer, the military can only defend its own networks, not the private-sector critical networks we all depend on for gas, water, electricity and banking.

Co-authored with computer scientist Ian Brown of the Oxford Internet Institute, UK, the report says online attacks are unlikely ever to have global significance on the scale of, say, a disease pandemic or a run on the banks. But they say "localised misery and loss" could be caused by a successful attack on the internet's routing structure, which governments must ensure are defended with investment in cyber-security training.

Jay Abbott, a security manager at the consultancy PricewaterhouseCoopers, agrees that the routing structure is indeed vulnerable. "Short of physically cutting the wires, it's the best way to take down a country from the internet," he says.

http://www.newscientist.com/article/dn19981-cyberwar-countermeasures-a-waste-of-money-says-report.html

Beware the seductions of sociable machines

- 17 January 2011 by **Sherry Turkle**
- Magazine issue 2795

A robot pet may start out being better than nothing but can end up better than the real thing (Image: Angela Wyant/Stone/Getty)

Our lives have become bold technological experiments, but we need to think hard before letting the computers and robots take over, says ***Sherry Turkle***

EVERYWHERE we turn, we face unprecedented technological change. On one hand there are the temptations of the sociable robots in the lab and on the horizon, machines that offer themselves as ready - or nearly ready - to talk to us about almost anything. Where once artificial intelligence researchers proposed artefacts that would win us over with their smartness, designers of these latest machines aim to seduce with sociability. Sociable robots press our "Darwinian buttons": we respond to humanoid objects that make eye contact, track our motion and say our names as "creatures" with intentions, consciousness, even feelings.

Indeed, when an object reaches out and asks us to care for it, we find we not only want to care for it, but want it to care for us in return. Nurturance turns out to be the "killer app" in our relationships with the inanimate. We are vulnerable to new attachments, seduced by machines that ask for our care. They "pretend" to converse, but do not understand what we say. Engrossed by sociable robots, we are alone yet experience a new sense of intimacy.

Nurturance is the killer app in our relationship with the inanimate

From another direction, there are the temptations of the new relationships we can have with each other via mobile connectivity - always on and always on us. We now expect the control over our time and emotional resources that texting and messaging provide. We don't use the "voice minutes" on our phones: we would rather text than talk. Talking comes to seem intrusive, a demand on our "real time". We turn instead to Facebook, to "friending", to Twitter, to worlds in which we play avatars - ourselves but not quite ourselves. In online spaces we discover a surprising truth about identity. When we play an "other" (as an avatar in World of Warcraft, say) we end up playing aspects of ourselves. When we go to places such as Facebook where we think we will simply be ourselves, we end up playing roles, caught up in self-presentation. In our lives of performance, we face confusions. At the end of an evening of avatar-to-avatar chat in a networked game we feel, at one moment, in possession of a full social life and, in the next, curiously isolated, in tenuous complicity with strangers. We recreate ourselves with new bodies, homes, jobs and romances. We build a Facebook following and wonder to what degree followers are friends. We are together with other people, yet can feel utterly alone.

Teenagers say that when they have a feeling, they turn to online contacts (on their phones, on Facebook) because sharing a feeling has become part of having one. In a world of continual connection, people who are a touch away are there for continual validation. We move from "I have a feeling, I want to make a call" to "I want to have a feeling, I need to send a text". When we use other people in this way, we can get used to seeing them as spare parts, as supports for our too-fragile selves.

So, alone with robots, we feel connected; together with people but not fully relating to them, we feel alone. We are in the still centre of a perfect storm. I call this the "robotic moment", a technological moment in which

we fear our lives with technology are out of control, and we fantasise, paradoxically, that it is technology that will help us re-establish control. Overwhelmed, we have been drawn to technologically mediated connections that seem low-risk, always at hand. If convenience and control continue to be the values we hold uppermost, we will be tempted by sociable robots which, just as slot machines attract a gambler, promise us excitement programmed in, just enough to keep us in the game.

At the robotic moment, we must also worry that we no longer complain about the simplification and reduction of relationships. We start down a path of substitution with the idea that technology provides alternatives that are better than nothing. Then we think that perhaps technology is better than some of the available human connections. Finally, we play with the idea that technology might be better than any human connection. From better than nothing to simply better.

An 11-year-old girl may start out saying that a robot dog might be better than a real one because her father is allergic to dogs. Next, she thinks that a robot dog is better than a real dog because it will "never die". Then the child may allow herself to muse that a robot dog could be made to stay a cute puppy, more gratifying than any real dog could ever be. From better than nothing to better than anything.

There is a similar progression in the world of connectivity. When lonely and isolated, creating an avatar in Second Life may seem better than nothing. But online, slim, rich and buffed up, you feel you have more opportunities than in the real world. Better than nothing becomes better than something - or better than anything. Not surprisingly, people report feeling let down when they move from virtual to real life.

Sociable robots and online life both suggest the possibility of relationships the way we want them. Just as we can program a made-to-measure robot, we can reinvent ourselves as comely avatars. We can write the Facebook profile that pleases us. We can edit messages until they project the self we want to be.

And we can keep things simple. Our new media are well suited to the rudimentary, and because this is what technology serves up, we reduce our expectations of each other. An impatient high-school senior says to me: "If you really need to reach me, just shoot me a text." He sounds just like my colleagues on a consulting job who tell me they would rather avoid face-to-face meetings and would prefer to communicate with "real-time texts".

Our first embrace with sociable robotics is a window onto what we want from technology - and what we will do to accommodate it. We imagine networked life as expansive, but we are as fond of its constraints. We celebrate its "weak ties", the bonds of acquaintance with people we may never meet, but that does not mean we prosper within them. We often stand depleted in the hype, finding ourselves tied up by the technology that promised to free us up.

Connectivity promises more time, but as smartphones erode boundaries between work and leisure, all the time in the world turns out to be not time enough. Even when not "at work", we feel on call. Pressed, we want to edit out complexity. Control and simplification in communication means that when it comes to relationships, we end up with reduction and betrayal, asking ourselves simpler questions because we want instant answers on email. We come to a point where we are so smitten by the idea of conversation with computers that we forget what human conversation about human problems is about: human meaning through the first-hand knowledge of the human life cycle, something of which robots will be forever innocent, no matter how "expressive" we make their faces or voices.

Every technology demands we ask whether it expresses our human values - and, in turn, that we ask ourselves what they are. This is a moment of significant choice. We have agreed to a series of experiments on ourselves: robots to mind children and the elderly, technologies that denigrate and deny privacy, seductive simulations that present themselves as real places to live. We deserve better. When we remind ourselves that it is we who decide how to keep technology busy, we will have better.

Profile

Sherry Turkle is Abby Rockefeller Mauzé Professor of the Social Studies of Science and Technology at the Massachusetts Institute of Technology. This essay is based on *Alone Together* (Basic Books), which with *The Second Self* and *Life on the Screen* completes her trilogy on digital life

http://www.newscientist.com/article/mg20927951.100-beware-the-seductions-of-sociable-machines.html?full=true&print=true

Crystal sieves could make oil sands greener

- 14 January 2011 by **Claudia Deutsch**
- Magazine issue 2794

Filter out the bad bits (Image: Veronique de Viguerie)

A FILTER made from natural crystals may help dirty, carbon-emitting fossil fuels green up.

Zeolite crystals are a popular industrial "sieve" because their tiny pore spaces allow only certain molecules to slip through. Now a group of researchers led by Steven Kuznicki at the University of Alberta in Edmonton, Canada, and Anthony Ku at General Electric think they can be used to screen out the carbon dioxide produced when processing or burning fossil fuels.

The vast oil-sand deposits of Alberta are estimated to hold up to 170 billion barrels of recoverable oil, second only to Saudi Arabia. But extracting the oil accounts for millions of tonnes of carbon emissions each year, and the industry is growing rapidly. Much of the emissions are generated when superheated steam is pumped into the deposits. The steam pushes oil to the surface, but also picks up carbon from the oil and surrounding bedrock, which is then released into the atmosphere.

The team found that passing such dirty steam through a zeolite crystal, such as the mineral clinoptilolite, traps everything but water, hydrogen, helium and ammonia. Carbon captured by the crystals could then be buried underground or utilised.

This technique could cut emissions related to oil sands by a quarter, the researchers say. The sieves could also work in coal gasification plants, which currently use solvents to scrub CO_2.

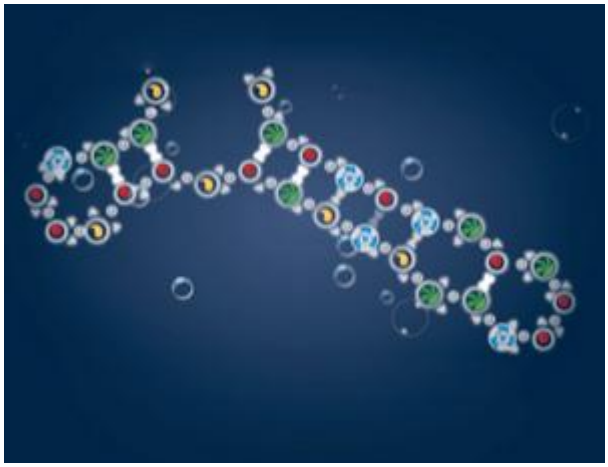
Passing the steam used to extract oil through a crystal 'sieve' could cut emissions by a quarter

Long-term stability and creating reliable, leak-free seals between crystals are still challenges, however. "We must prove we can go from a rock to a piece of equipment that really works," says Ku. He hopes to have a pilot plant running in Alberta in two years.

http://www.newscientist.com/article/mg20927944.100-crystal-sieves-could-make-oil-sands-greener.html?full=true&print=true

Online game helps predict how RNA folds

- 15:43 13 January 2011 by **Bob Holmes**



Now, can we make it for real? (Image: EteRNA/Carnegie Mellon University/Stanford University)

A novel hybrid of computer gaming and real-world biochemistry may soon give researchers the ability to predict the complex folding patterns of RNA molecules. This would allow them to synthesise bespoke molecules that can function as chemical sensors or be used in other applications.

The folding of RNA molecules is difficult to predict, because each molecule is a long string of units, or bases, that can pair up with each other in many different ways. Because of this, even the best computer algorithms do badly at predicting the shape a molecule will actually take.

A team led by computer scientist Adrien Treuille at Carnegie Mellon University in Pittsburgh, Pennsylvania, turned the problem over to online gamers to crack. "Instead of having powerful computers go through the data, why not have lots and lots of people do it?" says Treuille. Players of the game, called EteRNA, are given a target shape and can then join bases in any order.

With each change, the computer calculates the most likely shape of the folded RNA molecule, allowing players to adjust bases until they achieve their target.

Honing skills

EteRNA went public last week, and has already attracted about 5000 players. At first, players will hone their skills by designing simple shapes to hit the game's targets. Within a few months, though, the researchers hope to start them on harder, real-world problems. For example, Treuille hopes to design an RNA molecule that can change shape in the presence of another target molecule, thus acting as a sensor.

An earlier game, called FoldIt, which Treuille also helped design, lets players predict the shape of folded proteins. But because RNA molecules are quick and cheap to synthesise, the new game goes a step further. Each week, Treuille's colleague Rhiju Das of Stanford University in California, creates some of the molecules in his laboratory to see whether they really do take the predicted shape.

Virtual to real

So far, only 4 of about 40 tested have done so. However, the gamers are shown the molecules that worked and those which did not, allowing them to improve their predictions in the future.

For example, testers of a beta version of the game quickly learned that molecules with many repeating sequences of bases get "confused" and fold unpredictably – something biochemists had not realised before, Treille claims.

Integrating feedback from real-life experiments into online games keeps results realistic, but is no easy task. "If you have a video game, people can download it and play it," says Ingmar Riedel-Kruse, a bioengineer at Stanford who is not part of Treuille and Das's project. "If you have an experiment, it has to physically be sitting somewhere. Scaling it up to millions of people is difficult."

http://www.newscientist.com/article/dn19966-online-game-helps-predict-how-rna-folds.html?full=true&print=true

Chinese megacities foster unlikely green citizens

- 17:15 18 January 2011 by **Michael Marshall**
- Magazine issue 2796

They're big on recycling too (Image: Richard Jones/Rex Features)

Concrete megacities are not an obvious place to look for green citizens. Yet a new survey shows that, in China, the urban elite is most likely to get environmental gold stars.

Jianguo Liu of Michigan State University in East Lansing and colleagues quizzed 5073 people living in Chinese urban centres ranging from small country towns to Beijing and Shanghai.

They asked about six "green" activities like recycling, and found that people in larger cities were most likely to engage in them – the bigger the city, the greater the engagement. City-dwellers tend to be better educated and suffer more pollution, so may be more aware of the issues involved, says Liu.

Respondents with jobs, especially managerial ones, did more than the unemployed, which Liu thinks reflects China's reliance on powerful institutions to solve its problems. "Many environmental actions come from the top," he says. "Organisations provide time for employees to do 'green' actions like planting trees."

The survey shows urbanites are more eco-aware, but does that make them greener? It does not assess the effects of the respondents' actions. And Riley Dunlap of Oklahoma State University in Stillwater points out that it did not reach rural areas, where people may have more sustainable lifestyles. Nonetheless, it adds to a growing body of evidence that urban infrastructure encourages green behaviour.

Journal reference: *Environmental Conservation*, DOI: 10.1017/s037689291000086x

http://www.newscientist.com/article/dn19989-chinese-megacities-foster-unlikely-green-citizens.html?full=true&print=true

Casting a critical eye on climate models

- 17 January 2011 by **Anil Ananthaswamy**
- Magazine issue 2795

The better we understand our Earth, the better we can predict its future (Image: Rex Features)

Today's climate models are more sophisticated than ever – but they're still limited by our knowledge of the Earth. So how well do they really work?

CLIMATEGATE. Glaciergate. The past year or so has been a sordid time for climate science. It started with the stolen emails, which led to allegations that climate scientists had doctored data to demonstrate that humans are responsible for global warming. Then the world's most important organisation for monitoring climate change found itself in the dock for claiming that Himalayan glaciers would disappear by 2035, without the backing of peer-reviewed research. I admit feeling - as many surely did - a sense of unease. However unfounded the allegations, however minor the infractions, they only served to further cloud the debate over whether humans are irreparably changing Earth's climate.

Trying to unpick the arguments about human culpability and what the future holds for us hinges on one simple fact: there is only one Earth. That is not the opening line of a sentimental plea to protect our planet from climate change. Rather, it is a statement of the predicament faced by climate scientists. Without a spare Earth to experiment upon, they have to rely on computer models to predict how the planet is going to respond to human influence.

Today's climate models are sophisticated beasts. About two dozen of them, developed in the US, Europe, Japan and Australia, aim to predict the evolution of our climate over the coming decades and centuries, and the results are used by the Intergovernmental Panel on Climate Change (IPCC) to inform citizens and governments about the state of our planet and to influence policy.

But there is a snag. Our knowledge about the Earth is not perfect, so our models cannot be perfect. And even if we had perfect models, we wouldn't have the computing resources needed to run the staggeringly complex simulations that would be accurate to the tiniest details.

So modellers make approximations which naturally lead to a level of uncertainty in the results. Not surprisingly, this has led some people to rightly question the role of natural variability in climate relative to human influence, and the accuracy of the models. Others argue that the uncertainties in climate models are irrelevant compared with doubts over our ability to cut carbon dioxide emissions. So who is right?

To make sense of it all, it is worth retracing the beginnings of climate science. In the late 1850s, the Irish-born scientist John Tyndall showed that certain gases, including carbon dioxide, water vapour and ozone, absorb heat more strongly than the atmosphere as a whole, which is composed mainly of nitrogen and oxygen. Later, in 1895, Swedish physicist and chemist Svante Arrhenius calculated the effect of different amounts of CO_2, which makes up about 0.04 per cent of the atmosphere. From this work he predicted that doubling the CO_2 concentration would warm the Earth enough to cause glaciers to retreat.

More studies followed. In 1938, English engineer Guy Callendar calculated what is now called the Earth's climate sensitivity, which is the amount by which the planet will warm for every doubling in the amount of atmospheric CO_2. The figure he came up with was 2 °C.
Callendar was not without his critics, and the criticisms foreshadow those surrounding modern climate science. What about feedbacks due to increasing water vapour as the atmosphere warms? What about clouds? Would warming not increase cloud cover, which would block sunlight and thus cool the Earth?
Modern climate models aim to answer such questions. Each model represents the physical, chemical and biological processes that influence Earth's climate using equations that encapsulate our best understanding of the laws governing these processes. The idea is to solve these equations to predict future climate. To make solving them easier, modellers break up the planet into chunks, or grid cells, work out the results for each cell and then collate them into a bigger picture.
Typically, the models are initialised to some well-known state. Climate modellers usually settle on the year 1860 because it represents pre-industrial conditions. Temperature records exist from that time and we know the composition of the atmosphere from air trapped inside ice cores drilled from Greenland and elsewhere.
Once a model is initialised, it is made to step through time to see how the climate changes with each passing year. Modellers verify their predictions against existing measurements and refine their models, then run them further into the future to find out, say, the average global temperature or sea level in 2100.
The first models, developed in the 1970s, were simple by today's standards. They only studied the atmosphere's radiative forcing - the difference between the incoming and outgoing radiation energy - with particular emphasis on the effects of CO_2. These models were then coupled to so-called slab oceans, simplistic representations of oceans as a layer of water a few tens of metres thick that absorbed and released heat but had no dynamical properties, such as ocean currents. In 1979, the US National Academy of Sciences released the first report on global warming, based on two such models. Called the Charney report, it estimated that Earth's climate sensitivity could be anywhere between 1.5 and 4.5 °C.
Since then, the IPCC has used models of increasing complexity to produce reports in 1990, 1995, 2001 and 2007. Land surfaces, with their effects on energy flow, were included in the models. Observations of the extent of sea ice were used to assess the changes in reflectivity, or albedo, of oceans, which themselves became more than mere slabs and began to be modelled to their full depths. Volcanic activity and aerosols such as sulphates were added to the atmospheric mix, and the carbon cycle came in, to capture how carbon moves back and forth between the atmosphere, land and sea. Even some of the chemistry that alters the contents of the atmosphere was included.
The modellers were concerned mainly with radiative forcing - and as such prioritised processes to be modelled based on how much they contributed to warming. "The focus has always been on, first and foremost, heat," says John Dunne of the Geophysical Fluid Dynamics Laboratory in Princeton, New Jersey.
Still, there are important phenomena missing from the IPCC's most recent report. Consider a region that starts warming. This causes the vegetation to die out, leading to desertification and an increase in dust in the atmosphere. Wind transports the dust and deposits it over the ocean, where it acts as fertiliser for plankton. The plankton grow, taking up CO_2 from the atmosphere and also emitting dimethyl sulphide, an aerosol that helps form brighter and more reflective clouds, which help cool the atmosphere. This process involves carbon flow, aerosols, temperature changes, and so on, but all in specific ways not accounted for by each factor alone.
Despite huge advances, there are still important phenomena missing from the IPCC's latest report

Extra complexity

Such complex processes are now being incorporated into the most sophisticated models, including HadGEM3, developed by the UK Met Office's Hadley Centre in Exeter. Its predictions will be used in the next IPCC report in 2014. "We have got a whole complex cycle going on here that we didn't have before and that could well be important for climate," says Bill Collins, project manager for HadGEM3.
Models are not just increasing in complexity, they are also getting better at representing smaller and smaller regions of Earth. This helps assess the effect of factors such as changes in vegetation. The first IPCC report used models whose grid cells had a resolution of about 500 by 500 kilometres; the 2007 one's models had a resolution of about 110 kilometres across.
Surely, though, a higher number of parameters to measure leaves more room for uncertainty. That's true, according to Judith Curry, a climate scientist at the Georgia Institute of Technology in Atlanta. "The biggest

climate model uncertainty monsters are spawned by the complexity monster," writes Curry on her blog Climate Etc. Still, today's complex models are considered far better than the early ones because they incorporate our best knowledge of the Earth and climate processes.

Even so, these uncertainties lead to somewhat different predictions about future climate from different models, and provide fuel for those who question the efficacy of modelling. Possibly the biggest source of variation and uncertainty among the models is the way they deal with phenomena on small scales. Climate scientists and critics alike see this as a concern. It stems from the use of grid cells to model climate phenomena. For processes that span many grid cells, such as long-range atmospheric circulation, the models use equations to calculate how those processes evolve over time. But their resolution is just not good enough when it comes to calculating smaller processes, such as convection currents over oceans, the behaviour of clouds, the influence of aerosols on cloud formation, the transport of water through soil, and processes that occur at the microbial scale, such as respiring bacteria releasing CO_2 into the atmosphere.

In such cases, the processes are said to be parameterised: equations for them are solved outside the model and their results inserted. They then go on to influence the model's outcomes. Unfortunately, each model has its own way of parameterising sub-grid processes, leading to uncertainty in the outcome of simulations. "In terms of the behaviour of models, it's probably these parameterisations that have the biggest impact on the way a model will represent particular aspects of the climate," says Steve Woolnough of the National Centre for Atmospheric Sciences (NCAS) in Reading, UK.

This aspect was highlighted in the IPCC's 2007 report, which used a range of models to conclude that Earth would warm by between 2.5 and 4.5 °C with every doubling of CO_2 concentration. "Most of that range is probably attributable to the differences in parameterisations," says Woolnough.

Another problem is the issue of whether we understand some of these processes well enough in the first place. Take, for instance, the role in a warming climate of water vapour, which is a potent greenhouse gas.

It is generally thought that the amount of water vapour the atmosphere can hold increases with temperature. What is less certain is whether this water vapour remains in the atmosphere and contributes further to warming, or quickly leaves it as precipitation. Some recent studies suggest that humidity does indeed go up with warming, leading to yet more warming. These are short-term observations, however, and whether this holds over longer time scales is an open question (*Science*, vol 323, p 1020).

Differing predictions

While the debate continues, climate modellers are looking for a mechanism that could counteract any possible runaway heating due to water vapour. One large-scale phenomenon that has the potential to do so is cloud formation.

Unfortunately, clouds are even less well understood. Clouds can have either a warming or a cooling effect depending on the extent to which they block sunlight versus their ability to stop radiation reflected off Earth's surface from escaping back into space. High, thin clouds tend to stop more outgoing than incoming radiation, so their net effect is to warm the atmosphere. Low, thick clouds do the opposite. But clouds can have holes in them and the size of their water droplets can vary, both of which affect their reflectivity. On top of all that, clouds are small - too small to be modelled adequately. More complex models such as HadGEM3 incorporate aspects of cloud behaviour, but they are far from having all the answers.

Given such uncertainty, how can we ever trust model predictions? "If you ask all the different models the same question, they'll all get it wrong in different ways," says Dunne. But that is the key to their success. It is the differences between models that help to ensure predictions are in the right ball park.

The differences between climate models ensure that their predictions are in the right ball park

Today's models don't converge on predictions of, say, global temperature in 2100. Instead of relying on any one model, the IPCC uses an "ensemble" approach, using a slew of sophisticated models - each with its own bias - to narrow down the uncertainty. Studies have shown that the ensemble approach can outperform the predictions of any single model (*Bulletin of the American Meteorological Society*, vol 89, p 303).

What's more, despite all the caveats and weaknesses, one thing stands out: the prediction for Earth's climate sensitivity hasn't changed substantially from the 1979 Charney report to the IPCC's fourth assessment report in 2007. "People complain that the message hasn't changed," says Jerry Meehl of the National Center for Atmospheric Research in Boulder, Colorado. "Well, that's a good thing. If the message was changing every time we had an assessment that would make you nervous."

An even greater source of concern for climate modellers is how this warming will manifest regionally. The global mean temperature might rise by, say, 2 °C by 2100, but in north Africa it might rise by a lot more. Rainfall patterns might change dramatically from region to region, causing floods in some places and droughts elsewhere. But predicting regional level changes remains suspect. In the last IPCC report, all the big climate models were in serious disagreement when it came to predicting changes in precipitation on the sub-continental scales, let alone smaller regions. "That's where the effort needs to go," says Pier Luigi of NCAS. "That's what matters to people to manage their lives. That's the type of uncertainty we need to strive to resolve."

But creating regional models is an extremely difficult task. Still, that's what the IPCC is focusing on trying to improve.

Often forgotten in all the talk about temperature, clouds, rainfall and vegetation is the question of how the world's big ice sheets will react to a warming Earth. A lack of observational data means they are not well understood and can't be modelled in great detail. Will they melt and slide ever faster into the sea? Will they hold firm? "That's the big one. That's one that we are supremely unsuited to address well," says Dunne. "It's a big source of uncertainty if you want to know sea level."

And as I found out, that is the case with all things climate. If you want to know how the climate will be no further ahead than the next decade, natural variability in systems such as the El Niño/La Niña effect will trump any uncertainty in climate models. If you want to understand how the Earth will be in 50 years time, the decadal variations get averaged out and the uncertainty in climate models starts to rear its head, so improving our models will help us better predict the climate in 2060.

By 2100, however, both natural variability and the uncertainty in our models will make way for something that is far more uncertain: anthropogenic emissions. Will we get serious about cutting emissions, or continue with business as usual, or actually increase our emissions? "By late in the century, our choices come to dominate," says Richard Alley of the Pennsylvania State University at University Park, "and whatever you do with the climate models to make them better doesn't really matter that much".

Anil Ananthaswamy *is a consultant for New Scientist*

http://www.newscientist.com/article/mg20927951.400-casting-a-critical-eye-on-climate-models.html?full=true&print=true

Fall of Roman Empire linked to wild shifts in climate

- 19:00 13 January 2011 by **Michael Marshall**

Outlook is bleak (Image: Carlos Gotay/Getty)

Centuries of unpredictable climate may have been partly to blame for the fall of the western Roman Empire. A detailed record of 2500 years of European climate has uncovered several links between changing climate and the rise and fall of civilisations.

Climate fluctuation was a contributing factor alongside political failures and barbarian invasions, says Ulf Büntgen of the Swiss Federal Institute for Forest, Snow and Landscape Research in Birmensdorf, Switzerland, who led the project.

Büntgen used tree rings to build up a history of European climate. Using nearly 9000 samples from oak, pine and larch, Büntgen and colleagues were able to reconstruct how temperatures and rainfall in western Europe changed over the last 2500 years.

Climate flips and Black Death

From AD 250 to 550, the climate flipped, from one decade to the next, between dry and cool, and warm and wet. "Such decadal changes seem to have the most impact" on civilisations, Büntgen says, because they harm agriculture but are not prolonged enough for people to adapt their behaviour.

The climatic turmoil coincided with political upheaval and waves of human migrations. By AD 500, the western Roman Empire had fallen.

In other notable periods, the relatively stable medieval society was characterised by more constant climatic conditions. But the Black Death coincided with a wet spell and the disease spreads faster in humid conditions

Cold wars

"Relatively modest changes in European climate in the past have had profound implications for society," says Michael Mann of Penn State University in University Park, Pennsylvania.
Other studies have shown how war and climate are often intimately tied. For example, periods of unusually cold weather in China during the last millennium are thought to be linked to major bouts of warfare.
That said, it is difficult to draw conclusions for the present day from studies like Büntgen's. As Halvard Buhaug of the Peace Research Institute Oslo in Norway points out: "Modern societies are not nearly as dependent on the climate, because trade and technology can mitigate its effects."
Whether or not African civil wars today can be linked to modern climate change is the subject of intense debate.

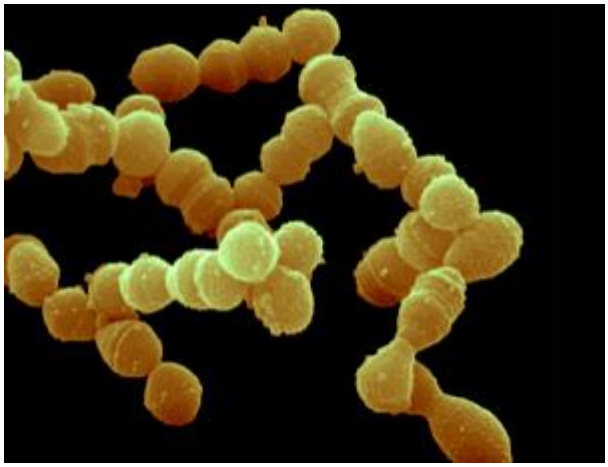
Huge sample size

Büntgen and his colleagues used over 7284 oak tree samples from low-lying areas of France and Germany to obtain a record of spring rainfall, and 1089 Stone pines samples and 457 larches samples from high in the Austrian Alps to determine summer temperatures.
Others, including Mann, have used similar methods to put together detailed reconstructions of global temperatures during the last 1000 years. Going back 2500 years is "a very substantial contribution," says Mann.
Journal reference: *Science*, DOI: 10.1126/science.1197175

http://www.newscientist.com/article/dn19968-fall-of-roman-empire-linked-to-wild-shifts-in-climate.html?full=true&print=true

Infectious moods: Bugs that cause bizarre behaviour

- 10:15 18 January 2011 by **Linda Geddes**
- Magazine issue 2795.



In rare cases streptococcus infections can cause severe personality changes (Image: Juergen Berger/SPL)

Sometimes it takes antibiotics, not a psychologist, to cure strange obsessions

Sammy Maloney was a healthy, outgoing 12-year-old, who played in the school band, and liked nothing better than to dump his backpack after school and hang out with his friends in Kennebunkport, Maine. Then, in 2002, Sammy's personality began to change. "The first thing I noticed was that he was walking around the backyard with his eyes closed," says Sammy's mother, Beth Maloney. "I asked him what he was doing, and he said he was memorising."

The next day, Sammy was again walking with his eyes closed and would only use the back door. Then he progressed to holding his breath while doing it, only wearing certain coloured clothes, and refusing to allow the windows to be opened, or the lights to be switched off. "Every single day was a new behaviour," says Beth. "We went from baseline to completely dysfunctional within a period of four to six weeks."

Sammy was diagnosed with obsessive compulsive disorder, and then Tourette's syndrome. When he continued to deteriorate, a friend suggested testing Sammy for streptococcus - a common childhood bacterial infection that usually causes no more than a sore throat. "By this point he was totally emaciated and he was covered with scabs from scratching himself," says Beth.

Sammy hadn't shown any signs of streptococcal infection, but it turned out he was infected. When doctors prescribed antibiotics, his symptoms began to improve. Within a few weeks he was playing board games with his brothers. "After six months of treatment, I knew that he would recover," says Beth.

Sammy remained on antibiotics for four years, as every time the dose was reduced he had a relapse. Now aged 20, Sammy has none of the compulsions that blighted his youth.

Madeline Cunningham at the University of Oklahoma in Oklahoma City says that, although extreme, Sammy's story isn't that unusual. She has spent years investigating behavioural disorders linked to childhood streptococcal infection, including Tourette's syndrome, an OCD-like disorder called PANDAS, and the movement disorder Syndenham's chorea, which is associated with tics and an inability to control emotions.

Cunningham has shown that, at least as far as Sydenham's chorea is concerned, antibodies against one group of streptococcal bacteria can bind to receptors in an area of the brain that controls movement. Here they mimic the effects of natural signalling molecules, triggering the release of the neurotransmitter dopamine, which may explain the tics and emotional problems experienced by children with the disorder (*Autoimmunity*, vol 39, p 21).

Not every child with PANDAS has similar antibodies, but for those that do antibiotics or drugs that suppress the immune system are effective treatments, says Cunningham. Preliminary evidence also links such antibodies to Tourette's syndrome.

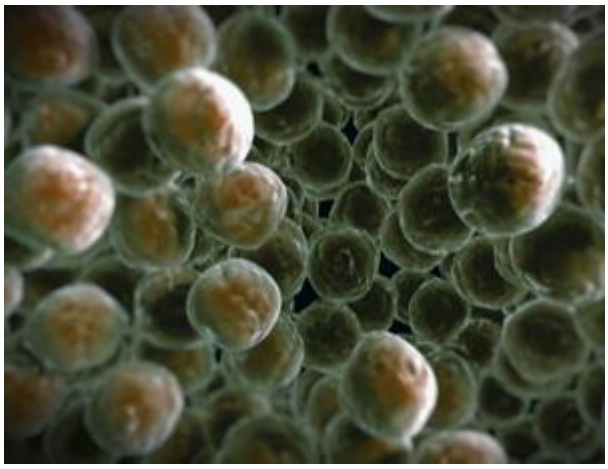
Cunningham stresses that there is no evidence that vaccination can trigger disorders like PANDAS. "You're more likely to get this from not being immunised," she says.
Meanwhile, Betty Diamond of the Feinstein Institute for Medical Research in Manhasset, New York, has also shown that antibodies associated with the autoimmune disease lupus can get into the brain and kill neurons by binding to NMDA receptors. This might partly explain the mood changes and cognitive decline associated with the disease.
Mouse studies suggest how behaviour is affected depends on what makes the blood-brain barrier leak, as well as on the antibodies themselves. When the barrier is compromised by inflammation, lupus-related antibodies damage the hippocampus, impairing memory. When the barrier is breached by stress hormones (adrenaline), the antibodies damage the amygdala, making individuals more fearful. The results were presented at a meeting of the American Association of Immunologists in Baltimore in May last year.
"This could change the way we treat mental disorders forever," says Cunningham, who thinks antibodies influence the behaviour even of apparently healthy individuals. "Your immune system develops based on what organisms it sees, and it could be that your brain does too."
Diamond agrees: "We have tonnes of antibodies even when we don't have clinical disease. I'm sure that some of these are having an effect on the brain."

Linda Geddes *is a New Scientist reporter based in London*

http://www.newscientist.com/article/dn19950-infectious-moods-bugs-that-cause-bizarre-behaviour.html?full=true&print=true

Explosive death for MRSA

- 09:00 17 January 2011 by **Catherine de Lange**



Divide and conquer no more (Image: David Scharf/Getty)

An antibody which causes MRSA bacteria to explode rather than divide brings hope for a universal vaccine.
MRSA is a highly antibiotic-resistant form of the bacteria *Staphylococcus Aureus* which kills about 20,000 people in the US alone each year. Although a small number of antibiotics work against MRSA, the bacteria is constantly evolving resistant strains.
Edward Schwartz and colleagues at the University of Rochester Medical Center in New York have identified an antibody which targets a protein called glucosaminidase (GMD) deep within MRSA that has a key role in breaking down the cell wall, enabling the bacterium to divide.
What's more, the protein is genetically identical in all strains, so a vaccine that targets GMD could potentially be universal.
The team grew MRSA in culture alongside the new antibody. Bacteria exposed to the antibody either fused into long chains or exploded, significantly inhibiting bacterial growth.
The research was presented on Saturday at the Orthopaedic Research Society meeting in Long Beach, California.

http://www.newscientist.com/article/dn19977-explosive-death-for-mrsa.html?full=true&print=true

Southern Sudan's votes could kill an ancient disease

- Updated 14:31 18 January 2011 by **Debora MacKenzie**

One less worm: this child in Southern Sudan is having a worm extracted – a scene that could soon be consigned to history (Image: J. Albertson/The Carter Center)

"There is huge excitement and euphoria here," says Makoy Samuel Yibi, phoning from Juba in Southern Sudan. There, this week's referendum vote looks set to divide Sudan into independent north and south countries, potentially ending decades of civil war. The result is largely a foregone conclusion: independence will be announced officially in February.

At the same time, as it does every February, Southern Sudan will report the year's first cases of a painful and ancient disease: guinea worm. But this could be the last time. Besides creating a new country, this week's vote could make guinea worm the second human disease – after smallpox – to be eradicated.

War and neglect have made Southern Sudan the worm's last stronghold. "If the political situation remains stable, we can stop it in 2012," says Makoy, director of the Southern Sudan ministry of health's guinea worm eradication programme.

Painful parasite

People swallow guinea worm larvae in infested water. The worms grow for a year, then emerge through the skin, so painfully that the victim seeks relief by plunging it into cool water. The worm then ejects its eggs, continuing the cycle.

Without human infections, the worms die out. Clean drinking water has wiped them out across Asia and much of Africa over the past few decades, but they have held on where poor people drink from stagnant ponds. Since 1986 The Carter Center, a charity headed by former US president Jimmy Carter, has helped these people filter water and keep emerging worms out of ponds. Now only four countries still have the worm – and of these, Ghana, Ethiopia and Mali are practically rid of it. Of the 1785 cases found last year, 1690 were in Southern Sudan.

At least this is 38 per cent fewer than the number of cases in 2009, says Don Hopkins, head of the guinea worm programme at The Carter Center, and the area affected has halved. The best he hopes for this year, however, is a further halving of cases.

Cattle conflict

The problem is still conflict, but it isn't between south and north, or even tribal, says Makoy. All 226 villages where people caught guinea worm last year suffered armed conflicts involving semi-nomadic herders over access to limited grazing and water. The disruption led both the campaign staff and those carrying the worms to flee, making it more difficult for staff to keep the worms away from water.

An independent Southern Sudan might finally end these conflicts, especially with foreign aid expected to flood in. More resources for the herders' cattle, says Makoy, would remove the reasons for the fights that block anti-worm activities in the last infected villages: ironically, more water sources for cattle could be what defeats this water-borne disease.

But final victory over guinea worm is far from assured. Southern Sudan is in ruins, and it is not yet clear how north and south will share crucial oil revenues after independence. Furthermore, refugees who fled the south years ago are returning with inflated expectations. Makoy fears that the euphoria generated by independence may backfire. "People will expect things to get better overnight, but they won't."

If the government finds ways to channel the euphoria into action, though, he says "eradicating guinea worm will be the peace dividend we can give the world".

http://www.newscientist.com/article/dn19975-southern-sudans-votes-could-kill-an-ancient-disease.html

Engineered chickens can't pass on flu

- 15:23 14 January 2011 by **Debora MacKenzie**

Flu-free by design? (Image: Norrie Russell, courtesy of Valerie White and The Roslin Institute)

Flu is hard to handle in chickens. Simply vaccinating them doesn't work very well: the vaccine must be precisely matched to the type of flu that is circulating, and even then vaccinated birds still transmit some virus. That virus then evolves, which may be what produced the H5N1 bird flu that has killed at least 306 people – as well as countless birds. So it would be great if we could genetically engineer chickens to resist all flu.

Flu carries its genes in eight chunks of RNA, each of which must bind to an RNA-replicating enzyme produced by the virus to reproduce itself – and the virus – during an infection. In an attempt to thwart this process, Laurence Tiley at the University of Cambridge and colleagues equipped chickens with DNA that produces a short hairpin-shaped molecule of RNA. This matches the short sequence on each of the eight chunks of flu RNA where the replicating enzyme binds. In tests in cultured chicken cells, the hairpin RNA bound to the replicating enzyme and prevented it from reproducing flu RNA.

It wasn't so simple in whole chickens, however. When birds engineered to make the hairpin RNA were infected with H5N1, the virus replicated in them nevertheless – to lethal effect. The birds still shed the virus too. But somehow none of the birds housed with them, engineered or not, caught the flu – although they caught it readily from non-engineered birds infected with H5N1.

Obscure mechanism

"The mechanism underlying this effect is not known," the team admits. The reason why non-infected chickens stayed flu-free wasn't that the virus mutated to become less dangerous, so that the target birds caught it but just didn't get sick – they didn't even develop antibodies to H5N1, showing they didn't catch the virus in the first place. It could be that the hairpin RNA interferes with recently discovered small RNA molecules made by the flu virus that help regulate infection.

"We consider these birds to be a first step towards producing robustly resistant chickens, and clearly it is important to understand the mechanism in as much detail as possible," says Tiley. The team plans to pass flu through the modified chickens repeatedly to see how it works – and assess any effects on the virus's evolution.

Whatever the mechanism, the hairpin RNA should work against all kinds of flu, unlike current vaccines. And the researchers say flu is unlikely to evolve to evade the hairpin's effect on its replicating enzyme – that would require the enzyme and its binding sites on all eight of flu's genome segments to mutate at once, which seems unlikely.

Ways around the block

Other ways to evade the block on transmission may well evolve, however, as maximising transmission is the main selection pressure on disease organisms. The question, says Andrew Read of Pennsylvania State University in University Park, is whether this makes the virus more or less dangerous.
"You can picture this leading to a more aggressive strain that would overcome whatever is stopping transmission," he says. "But it could also select for less virulent flu, that wouldn't kill the bird so fast, giving it more time to transmit to another host."
The way to test this would be to compare how viruses with low virulence and high virulence evolve in resistant hosts, says Read. Any animal with engineered resistance should be tested for its effect on pathogen evolution, he says, as similar experiments are likely to be tried in pigs and other animals that get flu, and with other animal diseases.
Even if such tests demonstrate that the GM animals are an effective way to combat flu, people may not want to eat the flu-proof animals. "Further development will undoubtedly stimulate debate about the application of this technology in food production," the team drily concludes.
Journal reference: *Science*, DOI: 10.1126/science.1198020

http://www.newscientist.com/article/dn19974-engineered-chickens-cant-pass-on-flu.html?full=true&print=true

Coriolis-like effect found 184 years before Coriolis

- 22:33 14 January 2011 by **MacGregor Campbell**

The cosmos loves irony. While trying to prove that the Earth is fixed in space, an Italian priest described something similar to the Coriolis effect – the slight deflection experienced by objects moving in a rotating frame of reference – nearly 200 years before mathematician Gustave Coriolis worked it out in 1835.
In 1651, Giovanni Riccioli published 77 arguments against the idea that the apparent motions of the heavens were due to the Earth's rotation and orbit around the sun. These included claims that Hell would be in the wrong place, aesthetic concerns over proportion and harmony, and more scientific approaches.
Now, Christopher Graney at Jefferson Community and Technical College in Louisville, Kentucky, has translated them from Latin, and discovered that Riccioli conjectured phenomena resembling the Coriolis effect (arxiv.org/abs/1012.3642).
Riccioli argued that if the Earth were rotating, the speed of the ground at different latitudes would be different, so cannon shots fired due north or south from near the equator would show a slight deflection east or west as the ground moved beneath them during flight. No such effect was known at the time, so he wrongly concluded that the Earth must be stationary.
In reality, the Coriolis effect is subtle, noticeable mainly in large-scale systems such as weather patterns and ocean currents.
Graney says that Riccioli is often ignored because of his anti-Copernican stance, but in the absence of more precise measurements, he says his reasoning in this case was sound. "Judging from the knowledge of the time, it was a pretty good argument," says Graney.
Still, historian Owen Gingerich, formerly of Harvard University, says Coriolis should retain credit for the idea because he recognised that – except for shots fired exactly on the equator – the deflection should occur for objects moving in any direction, not just north or south. "It shouldn't be confused with the genuine Coriolis force," Gingerich told *New Scientist*.

http://www.newscientist.com/article/dn19979-coriolislike-effect-found-184-years-before-coriolis.html?full=true&print=true

Loss of Reflectivity in the Arctic Doubles Estimate of Climate Models

Islands frozen in Frobisher Bay with mountains in the distance. Nunavut Canada. The cryosphere is the collective portion of the Earth's surface where water is in solid form and includes sea ice, snow, lake and river ice, glaciers, ice sheets and frozen ground. Most of these frozen areas are highly reflective, and "bounce" sunlight back into the atmosphere, keeping the Earth cooler than it would be without the cryosphere. (Credit: iStockphoto/Ryerson Clark)

ScienceDaily (Jan. 18, 2011) — A new analysis of the Northern Hemisphere's "albedo feedback" over a 30-year period concludes that the region's loss of reflectivity due to snow and sea ice decline is more than double what state-of-the-art climate models estimate.

The findings are important, researchers say, because they suggest that Arctic warming amplified by the loss of reflectivity could be even more significant than previously thought.

The study was published online this week in *Nature Geoscience*. It was funded primarily by the National Science Foundation, with data also culled from projects funded by NASA, the Department of Energy and others.

"The cryosphere isn't cooling the Earth as much as it did 30 years ago, and climate model simulations do not reproduce this recent effect," said Karen Shell, an Oregon State University atmospheric scientist and one of the authors of the study. "Though we don't necessarily attribute this to global warming, it is interesting to note that none of the climate models used for the 2007 International Panel on Climate Change report showed a decrease of this magnitude."

The cryosphere is the collective portion of the Earth's surface where water is in solid form and includes sea ice, snow, lake and river ice, glaciers, ice sheets and frozen ground. Most of these frozen areas are highly reflective, and "bounce" sunlight back into the atmosphere, keeping the Earth cooler than it would be without the cryosphere.

But as temperatures warm, ice and snow melts and reflectivity decreases, noted Shell, an assistant professor in OSU's College of Oceanic and Atmospheric Sciences.

"Instead of being reflected back into the atmosphere, the energy of the sun is absorbed by the Earth, which amplifies the warming," Shell said. "Scientists have known for some time that there is this amplification effect, but almost all of the climate models we examined underestimated the impact -- and they contained a pretty broad range of scenarios."

As part of the study, Shell, lead author Mark Flanner of the University of Michigan, and their colleagues compared Northern Hemisphere cryosphere changes between 1979 and 2008 in 18 different climate models to changes in actual snow, ice and reflectivity measurements of the same period. They determined that mean radiative forcing -- or the amount of energy reflected into the atmosphere -- ranged from 4.6 to 2.2 watts per meter squared.

During the 30-year study period, cryosphere cooling declined by 0.45 watts per meter squared. The authors attribute that decline equally to loss of snow and sea ice.

"Some of the decline may be natural climate variability," Shell said. "Thirty years isn't a long enough time period to attribute this entirely to 'forcing,' or anthropogenic influence. But the loss of cooling is significant. The rate of energy being absorbed by the Earth through cryosphere decline -- instead of being reflected back to the atmosphere -- is almost 30 percent of the rate of extra energy absorption due to carbon dioxide increase between pre-industrial values and today."

The "albedo" or reflectivity process is simple, scientists say, but difficult to measure on a broad scale. The reflectivity of ice and snow is obviously much greater than that of darker, unfrozen ground, or open sea water. But researchers also have discovered that variations in the snow and ice result in different albedo impacts. For example, pools of melted water on top of sea ice can have significantly less reflectivity, which in essence may speed up the warming and possibly melting of that sea ice.

"While the current group of models underestimates these Northern Hemisphere cryosphere changes, new models will be released this year that will have better representations of snow and ice," Shell said. "This study will help climate modelers improve the new generation of models to better predict the rate of cryosphere and albedo decline in the future."

Story Source:

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

Journal Reference:

1. M. G. Flanner, K. M. Shell, M. Barlage, D. K. Perovich, M. A. Tschudi. **Radiative forcing and albedo feedback from the Northern Hemisphere cryosphere between 1979 and 2008**. *Nature Geoscience*, 2011; DOI: 10.1038/ngeo1062

http://www.sciencedaily.com/releases/2011/01/110118123519.htm

Breakthrough in Converting Heat Waste to Electricity: Automotive, Chemical, Brick and Glass Industries Could Benefit from Discovery

By placing nanocrystals of rock salt into lead telluride, researchers have created a material that can harness electricity from heat-generating items such as vehicle exhaust systems. (Credit: iStockphoto/Steven Wilson)
ScienceDaily (Jan. 18, 2011) — Researchers at Northwestern University have placed nanocrystals of rock salt into lead telluride, creating a material that can harness electricity from heat-generating items such as vehicle exhaust systems, industrial processes and equipment and sun light more efficiently than scientists have seen in the past.

The material exhibits a high thermoelectric figure of merit that is expected to enable 14 percent of heat waste to electricity, a scientific first. Chemists, physicists and material scientists at Northwestern collaborated to develop the material. The results of the study are published by the journal *Nature Chemistry.*
"It has been known for 100 years that semiconductors have this property that can harness electricity," said Mercouri Kanatzidis, the Charles E. and Emma H. Morrison Professor of Chemistry in The Weinberg College of Arts and Sciences. "To make this an efficient process, all you need is the right material, and we have found a recipe or system to make this material."

Kanatzidis, co-author of the study, and his team dispersed nanocrystals of rock salt (SrTe) into the material lead telluride (PbTe). Past attempts at this kind of nanoscale inclusion in bulk material have improved the energy conversion efficiency of lead telluride, but the nano inclusions also increased the scattering of electrons, which reduced overall conductivity. In this study, the Northwestern team offers the first example of using nanostructures in lead telluride to reduce electron scattering and increase the energy conversion efficiency of the material.

"We can put this material inside of an inexpensive device with a few electrical wires and attach it to something like a light bulb," said Vinayak Dravid, professor of materials science and engineering at Northwestern's McCormick School of Engineering and Applied Science and co-author of the paper. "The device can make the light bulb more efficient by taking the heat it generates and converting part of the heat, 10 to 15 percent, into a more useful energy like electricity."

The automotive, chemical, brick, glass and any industry that uses heat to make products could make their system more efficient with the use of this scientific breakthrough, said Kanatzidis, who also has a joint appointment at the Argonne National Laboratory.

"The energy crisis and the environment are two major reasons to be excited about this discovery, but this could just be the beginning," Dravid said. "These types of structures may have other implications in the scientific community that we haven't thought of yet, in areas such as mechanical behavior and improving strength or toughness. Hopefully others will pick up this system and use it."

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

Journal Reference:

1. Kanishka Biswas, Jiaqing He, Qichun Zhang, Guoyu Wang, Ctirad Uher, Vinayak P. Dravid, Mercouri G. Kanatzidis. **Strained endotaxial nanostructures with high thermoelectric figure of merit**. *Nature Chemistry*, 2011; DOI: 10.1038/nchem.955

http://www.sciencedaily.com/releases/2011/01/110118143228.htm

Pulsating Star That Hosts a Giant Planet Discovered

Artist's impression shows a gas-giant exoplanet transiting across the face of its star. (Credit: ESA/C. Carreau)

ScienceDaily (Jan. 18, 2011) — A group of researchers from the Institute of Space Sciences (IEEC-CSIC) at Universitat Autònoma de Barcelona has discovered, for the first time, a delta Scuti pulsating star that hosts a hot giant transiting planet.

The study -- published recently in the journal *Astronomy & Astrophysics* -- was carried out by the PhD student, Enrique Herrero, the researcher Dr. Juan Carlos Morales, the exoplanet expert, Dr. Ignasi Ribas, and the amateur astronomer, Mr. Ramón Naves.

WASP-33 (also known as HD15082) is hotter, more massive than the Sun (1.5 Msun) and is located at a distance of 378 light years away, in the constellation of Andromeda. It has the peculiarity of being a star that pulsates radially, like a balloon that inflates and deflates continuously, and non-radially, like the tides in Earth's oceans caused by the presence of the moon, which deforms the bodies of water between the poles and the equator.

This star hosts a giant planet, WASP-33b, that was detected in 2006 through the transiting method. The planet's mass is four times the mass of Jupiter and it orbits the star at such a high speed that it only takes 1.2 days to complete its orbit. This very short orbital period indicates its extreme proximity to the star, 0.02 astronomical units (AU) when Mercury, the closest planet to the Sun, is at 0.39 AU. This planet is quite peculiar because it has a retrograde orbit and, even more so, its orbit is quite inclined in angle respect to the star's equator.

The study also suggests that the star's pulsations could be caused by the presence of the giant planet, something never seen before in any other planetary system. A small periodic signal, visible in the overall signal during the transit of the planet, called the attention of the researchers and through a thorough study, the pulsating modes of the star were determined and their possible relationship with the planet.

Apart from being a pioneering study in the field, it is noteworthy to mention that the observations have been obtained from professional and amateur observatories. For the first time in its recent activity history, the Montsec Astronomical Observatory (OAdM) has provided most of the observations used for this research. In addition, the amateur astronomer R. Naves, from the Montcabrer Observatory, has provided excellent data, revealing the great importance of Professional-Amateur collaborations in this field.
Therefore, the WASP-33 system represents a landmark in the world of exoplanets since it may provide vital information on pulsations modes that occur in stars, the effects of tides between stars and planets and the dynamical evolution of planetary systems.
Note: 1 UA = 149.597.870 km

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Universitat Autònoma de Barcelona**, via AlphaGalileo.

Journal Reference:

1. E. Herrero, J. C. Morales, I. Ribas, R. Naves. **WASP-33: the first δ Scuti exoplanet host star**. *Astronomy & Astrophysics*, 2011; 526: L10

http://www.sciencedaily.com/releases/2011/01/110118122548.htm

Magnetically Controlled Pill Could Boost Body's Absorption of Drugs

A place for everything A tiny magnet inside a gelatin capsule allow researchers to hold medicine at an exact place in the intestine where it is best absorbed. (Credit: Mathiowitz Lab/Brown University)

ScienceDaily (Jan. 18, 2011) — Do you want that in a pill or a shot? A pill, thank you, but most patients never have that choice. The problem with administering many medications orally is that a pill often will not dissolve at exactly the right site in the gastrointestinal tract where the medicine can be absorbed into the bloodstream. A new magnetic pill system developed by Brown University researchers could solve the problem by safely holding a pill in place in the intestine wherever it needs to be.

The scientists describe the harmless operation of their magnetic pill system in rats online the week of Jan. 17 in the *Proceedings of the National Academy of Sciences*. Applied to people in the future, said senior author Edith Mathiowitz, the technology could provide a new way to deliver many drugs to patients, including those with cancer or diabetes. It could also act as a powerful research tool to help scientists understand exactly where in the intestine different drugs are best absorbed.

"With this technology you can now tell where the pill is placed, take some blood samples and know exactly if the pill being in this region really enhances the bioavailability of the medicine in the body," said Mathiowitz, professor of medical science in Brown's Department of Molecular Pharmacology, Physiology, and Biotechnology. "It's a completely new way to design a drug delivery system."

The two main components of the system are conventional-looking gelatin capsules that contain a tiny magnet, and an external magnet that can precisely sense the force between it and the pill and vary that force, as needed, to hold the pill in place. The external magnet can sense the pill's position, but because the pill is opaque to x-rays, the researchers were also able to see the pill in the rat's bodies during their studies.

Safety first

The system is not the first attempt to guide pills magnetically, but it is the first one in which scientists can control the forces on a pill so that it's safe to use in the body. They designed their system to sense the position of pills and hold them there with a minimum of force.

"The most important thing is to be able to monitor the forces that you exert on the pill in order to avoid damage to the surrounding tissue," said Mathiowitz. "If you apply a little more than necessary force, your pill will be pulled to the external magnet, and this is a problem."

To accomplish this, the team including lead author and former graduate student Bryan Laulicht took careful measurements and built an external magnet system with sophisticated computer control and feedback mechanisms.

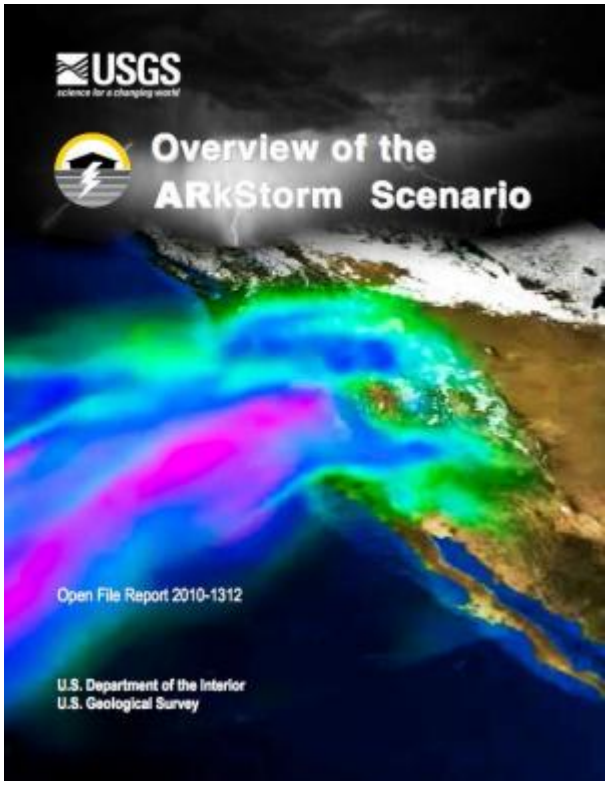
"The greatest challenges were quantifying the required force range for maintaining a magnetic pill in the small intestines and constructing a device that could maintain intermagnetic forces within that range," said Laulicht, who is now a postdoctoral scholar at MIT.

Even after holding a pill in place for 12 hours in the rats, the system applied a pressure on the intestinal wall that was less than 1/60th of what would be damaging.
The next step in the research is to begin delivering drugs using the system and testing their absorption, Mathiowitz and Laulicht said.
"Then it will move to larger animal models and ultimately into the clinic," Laulicht said. "It is my hope that magnetic pill retention will be used to enable oral drug delivery solutions to previously unmet medical needs."
In addition to Mathiowitz and Laulicht, authors on the paper include Brown researchers Nicholas Gidmark and Anubhav Tripathi. Brown University funded the research.

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

http://www.sciencedaily.com/releases/2011/01/110117152737.htm

ARkStorm: California's Other 'Big One'



Cover of "Overview of the ARkStorm Scenario". (Credit: Image courtesy of United States Geological Survey)

ScienceDaily (Jan. 18, 2011) — For emergency planning purposes, scientists unveiled a hypothetical California scenario that describes a storm that could produce up to 10 feet of rain, cause extensive flooding (in many cases overwhelming the state's flood-protection system) and result in more than $300 billion in damage. The "ARkStorm Scenario," prepared by the U.S. Geological Survey and released at the ARkStorm Summit in Sacramento on Jan. 13-14, combines prehistoric geologic flood history in California with modern flood mapping and climate-change projections to produce a hypothetical, but plausible, scenario aimed at preparing the emergency response community for this type of hazard.

The USGS, the Federal Emergency Management Agency and the California Emergency Management Agency convened the two-day summit to engage stakeholders from across California to take action as a result of the scenario's findings, which were developed over the last two years by more than 100 scientists and experts.

"The ARkStorm scenario is a complete picture of what that storm would do to the social and economic systems of California," said Lucy Jones, chief scientist of the USGS Multi-Hazards Demonstration Project and architect of ARkStorm. "We think this event happens once every 100 or 200 years or so, which puts it in the same category as our big San Andreas earthquakes. The ARkStorm is essentially two historic storms (January 1969 and February 1986) put back to back in a scientifically plausible way. The model is not an extremely extreme event."

Jones noted that the largest damages would come from flooding -- the models estimate that almost one-fourth of the houses in California would experience some flood damage from this storm.

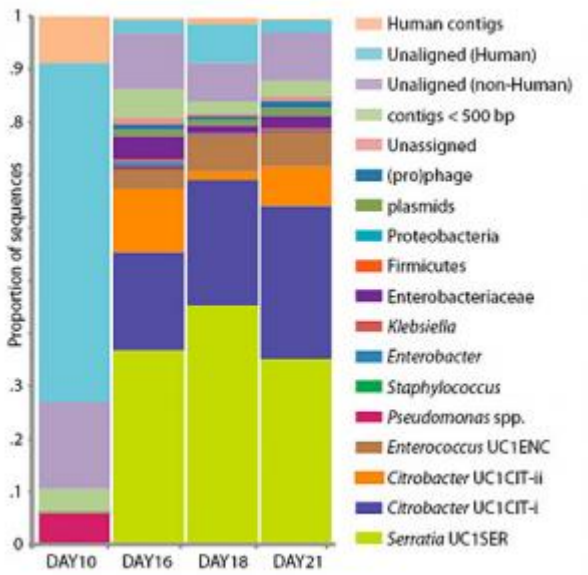
"The time to begin taking action is now, before a devastating natural hazard event occurs," said USGS Director, Marcia McNutt. "This scenario demonstrates firsthand how science can be the foundation to help build safer communities. The ARkStorm scenario is a scientifically vetted tool that emergency responders, elected officials and the general public can use to plan for a major catastrophic event to help prevent a hazard from becoming a disaster."

To define impacts of the ARkStorm, the USGS, in partnership with the California Geological Survey, created the first statewide landslide susceptibility maps for California that are the most detailed landslide susceptibility maps ever created. The project also resulted in the first physics-based coastal storm modeling system for analyzing severe storm impacts (predicting wave height and coastal erosion) under present-day scenarios and under various climate-change and sea-level-rise scenarios.
Because the scenario raised serious questions about existing national, state and local disaster policy and emergency management systems, ARkStorm became the theme of the 2010 Extreme Precipitation Symposium at U.C. Davis John Muir Institute of the Environment, attracting over 200 leaders in meteorology and flood management. ARkStorm is part of the efforts to create a National Real-Time Flood Mapping initiative to improve flood management nationwide. ARkStorm also provided a platform for emergency managers, meteorologists and hydrologists to work together to develop a scaling system for west coast storms.
"Cal EMA is proud to partner with the USGS in this important work to protect California from disasters," said Cal EMA Acting Secretary Mike Dayton. "In order to have the most efficient and effective plans and response capabilities, we have to have the proper science to base it on. Californians are better protected because of the scientific efforts of the United States Geological Survey."
According to FEMA Region IX Director, Nancy Ward, "The ARkStorm report will prove to be another invaluable tool in engaging the whole of our community in addressing flood emergencies in California. It is entirely possible that flood control infrastructure and mitigation efforts could be overwhelmed by the USGS ARkStorm scenario, and the report suggests ways forward to limit the damage that is sure to result."
The two-day summit included professional flood managers, emergency mangers, first responders, business continuity managers, forecasters, hydrologists and decision makers. Many of the scientists responsible for coordinating the ARkStorm scenario presented the science behind the scenario, including meteorology, forecasting, flood modeling, landslides and physical and economic impacts.
The ARkStorm Scenario is the second scenario from the USGS Multi-Hazards Demonstration Project led by Jones, which earlier created the ShakeOut earthquake scenario. More information about the ARkStorm Summit is online (http://urbanearth.usgs.gov/arkstorm-summit/). The ARkStorm Scenario, USGS Open-File Report 2010-1312, is also online (http://pubs.usgs.gov/of/2010/1312/).

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **United States Geological Survey**.

http://www.sciencedaily.com/releases/2011/01/110117142512.htm

Scientists Sequence Gut Microbes of Premature Infant



The microbes in the gut of a premature infant change radically from day 10 and days 16-21, as indicated by the colored bars keyed to different microbial groups. Even day to day, the relative proportions of microbes shifts, and probably continues to change as the baby encounters new environments, people and pets. (Credit: Image courtesy of University of California - Berkeley)

ScienceDaily (Jan. 18, 2011) — Scientists have for the first time sequenced and reconstructed the genomes of most of the microbes in the gut of a premature newborn and documented how the microbe populations changed over time.

Further studies involving more infants could eventually help researchers understand the causes of various intestinal problems that afflict preemies, in particular the sometimes fatal necrotizing enterocolitis, according to researchers at the University of California, Berkeley, the University of Pittsburgh School of Medicine and Stanford University. One unresolved question is whether these illnesses are caused by pathogenic strains of bacteria or just an imbalance in the microbe populations in the gut.

The study was posted online Dec. 29 in advance of print publication in the journal *Proceedings of the National Academy of Sciences*.

While this is not the first time that microbes in the human intestinal tract have been sequenced as a community, this is the first comprehensive look at a time series documenting colonization of the gut of a premature newborn, and one of few completely assembled community genomic datasets, said Jill Banfield, a UC Berkeley professor of earth and planetary science and of environmental science, policy and management. "Sequencing of microbial communities has become exceedingly common, but many researchers work with essentially unassembled data and often analyze very short contiguous DNA sequences -- genome fragments," she said. "We actually go in and work out where the assemblies failed and fix them -- what's called curating the data -- so we can build very complete genomes for most of the microbes."

From acid mines to the preemie gut

Pediatric surgeon Michael J. Morowitz, until recently at The University of Chicago Medical Center but now with Children's Hospital of Pittsburgh of the University of Pittsburgh Medical Center and an assistant professor of surgery at the University of Pittsburgh School of Medicine, first approached Banfield because of her pioneering work over the past decade sequencing microbial communities in extreme environments, such as the acid drainage from underground mines. He suggested that she tackle a unique human environment, the newborn intestinal tract. Unlike the adult gut, which may contain a couple of thousand microbial species, the newborn's intestinal tract may be colonized by only a handful, making it feasible to sequence the entire community.

His interest stemmed from work with premature infants, most of whom spend anywhere from two weeks to six months in the intensive care unit before they're deemed healthy enough to go home. Between 5 and 10 percent of these preemies develop symptoms of necrotizing enterocolitis (NEC), which requires rounds of antibiotics to halt, and perhaps a third of these babies eventually require surgery to remove parts of their intestines that have died.

"The actual impact of necrotizing enterocolitis in the ICU is even larger, because feeding routines and other care are conducted around a fear of NEC developing," Morowitz said.

Previous studies, however, have produced conflicting results about NEC's cause. Some have found pathogenic bacteria associated with NEC, while others have found no difference between the bacteria in babies with and without NEC. Banfield, Morowitz and their collaborators suspect that these results reflect the fact that researchers have looked broadly at species or families of bacteria in the gut, rather than at variants or strains. Although coexisting strains may have genes that are 99 percent identical, their genomes could be sufficiently distinct to make one bad and the other good.

"We already know that just a few genes can make one strain a pathogen and one beneficial or commensal," meaning that the microbes live amicably with their host, Banfield said. "We expect that a lot of the issues with the colonization process in the gut that leads to disease may be tracked to subtle differences in strains," she said. "So one question on the table is, 'Are these very closely related strains physiologically distinct, and in what ways'?"

The only way to get at these differences, she said, is to sequence the entire genomes of the intestinal microbiota -- not merely DNA fragments or short DNA tags, which can be used to identify the genus or even species of a microbe, but not the specific strain.

Colonizing the gut

"Although a primary target of our research is NEC, it's become very apparent that there are some fundamental unanswered questions just about the colonization process under normal circumstances," Morowitz added. "It's really important to get a handle on what the normal process is first, and then, eventually, we can look closely at babies with NEC and see if they deviate from what appears to be the normal colonization process."

Other human diseases, including asthma, diabetes and obesity, have been linked to problems with microbial colonization of the gut, and several papers have reported symptomatic improvement after "transplanting" fecal material from healthy individuals to patients with a range of intestinal disorders.

Banfield, Morowitz and their colleagues followed a single premature infant that had been delivered by cesarean and identified three distinct communities of intestinal microbes present at different times during the first month of the infant's life. The microbe populations in these communities seemed to change after alterations in medication and feeding, Morowitz said. Although it was presumably sterile at birth, the infant's gut was quickly colonized by a set of known intestinal microbes -- bacteria and Archaea, primarily, but also viruses, bacterial viruses (phage) and the naked lengths of DNA called plasmids. When the baby went off antibiotics and switched from breast feeding to intravenous feeding, the microbe populations completely changed, with minor microbial members suddenly dominating and dominant members declining.

Vincent Denef, a post-doctoral researcher in Banfield's lab who contributed to the study, noted that such real-time studies are powerful because "very rarely do we have the opportunity to observe the dynamics of a naturally occurring system, such as the infant GI tract, as it is transformed from sterile to functionally diverse."

The populations again shifted when intravenous feeding was replaced by formula. Morowitz stopped collecting feces from dirty diapers after 21 days, and the infant was sent home healthy after 9 weeks in the ICU.

Though fecal samples were taken nearly every day, a complete genome analysis was performed only for samples collected on days 10, 16, 18 and 21. For the other days, the microbial community was estimated based on DNA tags (16S rRNA) that identify microbe families and species, but not specific strains.

What distinguishes bad from good microbes?

What surprised the researchers is that the microbial population was comprised of members of at least 20 groups, many of which include harmful as well as benign organisms. These included *Staphylococcus*, a frequent cause of hospital infections; *Pseudomonas*, "the cause of an enormous amount of morbidity in ICU patients, both children and adults," Morowitz said; *Serratia*, a common cause of sepsis in general; and *Citrobacter*, which can cause meningitis in babies. Yet, the baby in this study appeared healthy throughout.

"The gut populations are highly dynamic, with large shifts through three stages over time, but we saw an overabundance of gram-negative organisms that we often associate with disease," he said. "Particularly striking was the dominance of *Pseudomonas* for several days, though the infant was clinically stable."
The seeming contradiction of a healthy infant with disease-causing bacteria in her gut could be explained if the strains in the infant's gut were benign, or if the balance of other microbes prevented pathogenic microbes from causing problems.
Citrobacter, for example, is one type of bacteria that is reportedly associated with NEC: one study found *Citrobacter* in three of four infants with NEC, but in no control infants. Yet, in the current study, sequencing of the gut microbiome on days 16, 18 and 21 revealed the presence of two strains of *Citrobacter*, which fluctuated significantly in proportions on the three days. "Those big shifts could potentially have been very important for the medical state of that baby," Banfield said. "Fortunately, the baby was fine."
The researchers found that those two strains were 99 percent similar over areas of the genome that could be compared.
"Of particular interest were hot spots of rapid DNA evolution within and between genes. Those potentially could be very important and interesting," she said. "Though the two *Citrobacter* genotypes are very, very similar over most of the genome, the results suggest that they could be functioning in different ways because their genomes are regulated differently."
Banfield noted that the intestinal community of the infant no doubt would continue to shift repeatedly for a year or more after birth, as the child encounters new microbes -- courtesy of family, friends and pets. These populations shift with the influx of new strains and species and potentially because the resident microbes themselves evolve by picking up new traits from the plasmids and phages living alongside them.
"This is an ecological study," she emphasized. "One of the things we are trying to do is bring into the field of medicine a high resolution, ecological approach."
Other coauthors of the study are Brian C. Thomas of UC Berkeley, Valeriy Poroykoa of the University of Chicago Pritzker School of Medicine, and David A. Relman and Elizabeth K. Costello of the Stanford University School of Medicine.
The work was funded by National Institute of Allergy and Infectious Diseases of the National Institutes of Health, the Department of Energy, the Surgical Infection Society and The March of Dimes.

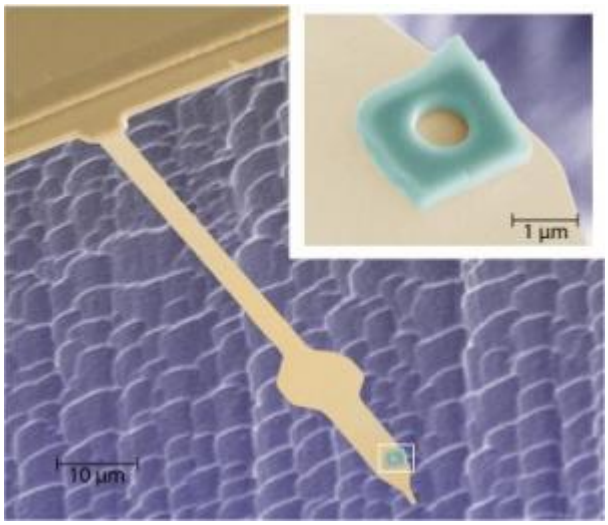
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of California - Berkeley**. The original article was written by Robert Sanders, Media Relations.

Journal Reference:

1. M. J. Morowitz, V. J. Denef, E. K. Costello, B. C. Thomas, V. Poroyko, D. A. Relman, J. F. Banfield. **Strain-resolved community genomic analysis of gut microbial colonization in a premature infant**. *Proceedings of the National Academy of Sciences*, 2010; DOI: 10.1073/pnas.1010992108

http://www.sciencedaily.com/releases/2011/01/110113131624.htm

Physicists Observe Exotic State in an Unconventional Superconductor



This is a false-color image of a single-crystal Si cantilever and its attached annular SRO particle. Inset: Scanning electron microscope image of the SRO "ring" with a 0.7-µm diameter hole. (Credit: Raffi Budakian, University of Illinois)

ScienceDaily (Jan. 17, 2011) — A new fractional vortex state observed in an unconventional superconductor may offer the first glimpse of an exotic state of matter predicted theoretically for more than 30 years. In a paper published in the January 14 issue of *Science*, University of Illinois physicists, led by Raffi Budakian, describe their observations of a new fractional vortex state in strontium ruthenium oxide (SRO). Such states may provide the basis for a novel form of quantum computing in which quantum information is encoded in the topological properties of a physical system.

"We've been on the trail of a state of matter called a half-quantum vortex for more than three years," said Budakian. "First proposed in the 1970s to exist in superfluid helium-3, a half-quantum vortex can be thought of as a 'texture' that arises from the spin phase of the superconducting order parameter."

Budukian's group investigated strontium ruthenium oxide (SRO), an unconventional superconductor that has been proposed as the solid-state analog of the A-phase of superfluid helium-3. Using state-of-the-art nanofabrication methods and exquisitely sensitive cantilever-based magnetometry techniques developed by the group, the researchers observed minute fluctuations in the magnetism of tiny rings of SRO.

"Strontium ruthenium oxide is a unique and fascinating material, and the half-quantum vortices that have been conjectured to exist in it are particularly interesting," said Anthony J. Leggett, the John D. and Catherine T. MacArthur Professor and Center for Advanced Study Professor of Physics, who shared the 2003 Nobel Prize in Physics for his work on superfluid helium-3. "It is believed that these half-quantum vortices in SRO may provide the basis for topological quantum computing. If this novel form of computing is eventually realized, this experiment will certainly be seen as a major milestone along the road there."

Budakian is an assistant professor of physics and a principal investigator in the Frederick Seitz Materials Research Laboratory at Illinois. Five years ago, he was instrumental in pioneering a technique, magnetic resonance force microscopy, to measure the force exerted on a micrometer-scale silicon cantilever by the spin of a single electron in a bulk material. He and his group have now adapted their ultrasensitive cantilever measurements to observe the magnetic behavior of SRO.

In the experiment, the researchers first fabricated a micron-sized ring of SRO and glued it to the tip of the silicon cantilever. How small are these rings? Fifty of them would fit across the width of a human hair. And the tips of the cantilevers are less than 2 µm wide.

"We take the high-energy physics approach to making these rings. First we smash the SRO, and then we sift through what's left," said Budakian.

The researchers first pulverize the large crystals of SRO into fragments, choose a likely micron-sized flake, and drill a hole in it using a focused beam of gallium ions. The resulting structure, which looks like a

microscopic donut, is glued onto the sensitive silicon cantilever and then cooled to 0.4 degrees above absolute zero.

"Positioning the SRO ring on the cantilever is a bit like dropping one grain of sand precisely atop a slightly larger grain of sand," said Budakian, "only our 'grains of sand' are much smaller."

Budakian added that this technique is the first time such tiny superconducting rings have been fabricated in SRO.

Being able to make these rings is crucial to the experiment, according to Budakian, because the half-quantum vortex state is not expected to be stable in larger structures.

"Once we have the ring attached to the cantilever, we can apply static magnetic fields to change the 'fluxoid' state of the ring and detect the corresponding changes in the circulating current. In addition, we apply time-dependent magnetic fields to generate a dynamic torque on the cantilever. By measuring the frequency change of the cantilever, we can determine the magnetic moment produced by the currents circulating the ring," said Budakian.

"We've observed transitions between integer fluxoid states, as well as a regime characterized by 'half-integer' transitions," Budakian noted, "which could be explained by the existence of half-quantum vortices in SRO."

In addition to the advance in fundamental scientific understanding that Budakian's work provides, the experiment may be an important step toward the realization of a so-called "topological" quantum computer, as Leggett alluded.

Unlike a classical computer, which encodes information as bits whose values are either 0 or 1, a quantum computer would rely on the interaction among two-level quantum systems (e.g., the spins of electrons, trapped ions, or currents in superconducting circuits) to encode and process information. The massive parallelism inherent in quantal time evolution would provide rapid solutions to problems that are currently intractable, requiring vast amounts of time in conventional, classical machines.

For a functional quantum computer, the quantum bits or "qubits" must be strongly coupled to each other but remain sufficiently isolated from random environmental fluctuations, which cause the information stored in the quantum computer to decay -- a phenomenon known as decoherence. Currently, large-scale, international projects are underway to construct quantum computers, but decoherence remains the central problem for real-world quantum computation.

According to Leggett, "A rather radical solution to the decoherence problem is to encode the quantum information nonlocally; that is, in the global topological properties of the states in question. Only a very restricted class of physical systems is appropriate for such topological quantum computing, and SRO may be one of them, provided that certain conditions are fulfilled in it. One very important such condition is precisely the existence of half-quantum vortices, as suggested by the Budakian experiment."

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Story Source:

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

Journal Reference:

1. J. Jang, D. G. Ferguson, V. Vakaryuk, R. Budakian, S. B. Chung, P. M. Goldbart, and Y. Maeno. **Observation of Half-Height Magnetization Steps in Sr_2RuO_4**. *Science*, 2011; 331 (6014): 186-188 DOI: 10.1126/science.1193839

http://www.sciencedaily.com/releases/2011/01/110113141617.htm

Chandra Images Torrent of Star Formation

M82 is a so-called starburst galaxy where stars are forming much more frequently than normal galaxies. This new deep Chandra image reveals hundreds of point-like X-ray sources, some of which likely contain black holes. (Credit: NASA/CXC/Wesleyan/R.Kilgard et al.)

ScienceDaily (Jan. 17, 2011) — A new Chandra X-ray Observatory image of Messier 82, or M82, shows the result of star formation on overdrive. M82 is located about 12 million light years from Earth and is the nearest place to us where the conditions are similar to those when the Universe was much younger with lots of stars forming.

M82 is a so-called starburst galaxy, where stars are forming at rates that are tens or even hundreds of times higher than in a normal galaxy. The burst of star birth may be caused by a close encounter or collision with another galaxy, which sends shock waves rushing through the galaxy. In the case of M82, astronomers think that a brush with its neighbor galaxy M81 millions of years ago set off this torrent of star formation.

M82 is seen nearly edge-on with its disk crossing from about 10 o'clock to about 4 o'clock in this image from Chandra (where low, medium, and high-energy X-rays are colored red, green, and blue respectively.) Among the 104 point-like X-ray sources in the image, eight so far have been observed to be very bright in X-rays and undergo clear changes in brightness over periods of weeks and years. This means they are excellent candidates to be black holes pulling material from companion stars that are much more massive than the Sun. Only a handful of such binary systems are known in the Local Group of galaxies containing the Milky Way and M31.

Chandra observations are also important in understanding the rapid rate at which supernovas explode in starburst galaxies like M82. When the shock waves travel through the galaxy, they push on giant clouds of gas and dust, which causes them to collapse and form massive stars. These stars, in turn, use up their fuel quickly and explode as supernovas. These supernovas produce expanding bubbles of multimillion-degree gas that extend for millions light years away from the galaxy's disk. These bubbles are seen as the large red areas to the upper right and lower left of the image.

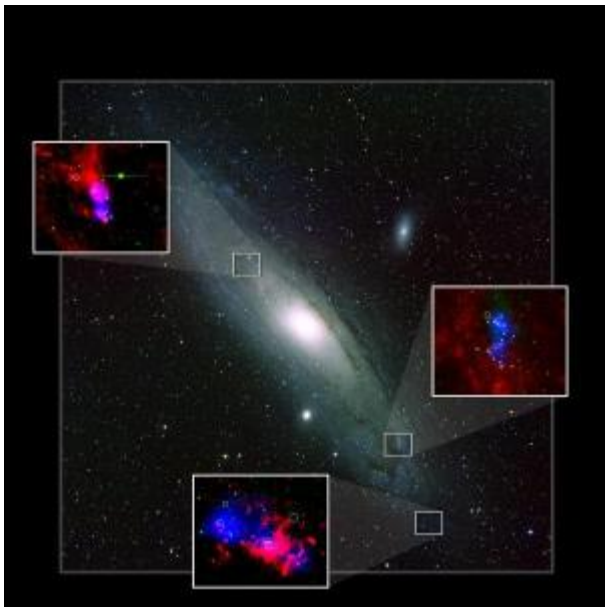
NASA's Marshall Space Flight Center in Huntsville, Ala., manages the Chandra program for NASA's Science Mission Directorate in Washington. The Smithsonian Astrophysical Observatory controls Chandra's science and flight operations from Cambridge, Mass.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Chandra X-ray Center**.

http://www.sciencedaily.com/releases/2011/01/110113160915.htm

In Distant Galaxies, New Clues to Century-Old Molecule Mystery



Andromeda, shown here, is one of two distant galaxies where astronomers recently searched for diffuse interstellar bands (DIBs). If DIBs were found when looking in a straight line from Earth to a star in the galaxy, the star is circled. Bigger circles indicate stronger DIBs. An "x" means no DIBS were observed. The colors in the insets correspond to wavelengths of the spectrum: blue for UV, green for visible light, and red for infrared. (Credit: M31 image by Bill Schoening, Vanessa Harvey/REU program/NOAO/AURA/NSF. Insets from Nick Cox, Institute for Astronomy, K.U. Leuven)

ScienceDaily (Jan. 18, 2011) — In a study that pushes the limits of observations currently possible from Earth, a team of NASA and European scientists recorded the "fingerprints" of mystery molecules in two distant galaxies, Andromeda and the Triangulum. Astronomers can count on one hand the number of galaxies examined so far for such fingerprints, which are thought to belong to large organic molecules, says the team's leader, Martin Cordiner of the Goddard Center for Astrobiology at NASA's Goddard Space Flight Center in Greenbelt, Md.

Figuring out exactly which molecules are leaving these clues, known as "diffuse interstellar bands" (DIBs), is a puzzle that initially seemed straightforward but has gone unsolved for nearly a hundred years. The answer is expected to help explain how stars, planets and life form, so settling the matter is as important to astronomers who specialize in chemistry and biology as determining the nature of dark matter is to the specialists in physics.

Cordiner is presenting the team's research at the American Astronomical Society meeting in Seattle, Wash., on Jan. 10, 2011, and the results from Andromeda were published in an *Astrophysical Journal* paper on Jan. 1. The findings provide some evidence against one of the top candidates on the list of suspects: polycyclic aromatic hydrocarbons (PAHs), a group of molecules that is widespread in space. The research also reveals that some of the signatures found in Andromeda and the Triangulum are similar to ones seen in our own Milky Way, despite some big differences between those galaxies and ours.

"We have studied DIBs in incredibly diverse environments. Some have low levels of UV radiation. Some have radiation levels thousands of times higher. Some have different amounts of 'ingredients' available for making stars and planets," Cordiner says. "And throughout all of these, we see DIBs."

Missing in action

Until now, only two galaxies beyond our own have been investigated in detail for DIBs. Those are our nearest neighbors, the Large and Small Magellanic Clouds, which lie 160,000 to 200,000 light years away. (Researchers have conducted selective studies elsewhere, however.)

Andromeda and the Triangulum are located much farther away, at about 2.5 to 3 million light years from Earth. "At those distances, individual stars are so faint that we need to push even the largest telescopes in the world to their limits in order to observe them," Cordiner says.

That statement might seem strange to anyone who has looked into the night sky and seen either of these galaxies with the naked eye. Under favorable conditions, the galaxies appear as smudges in the constellations that bear their respective names.

But to study DIBs, researchers need to do much more than see that the galaxy is there. They have to pick out individual stars within the galaxy, and only a few telescopes worldwide are powerful enough to gather sufficient light for that. (The team used the Gemini Observatory's telescope in Hawaii.) This is why most DIBs found so far have been in the Milky Way.

Whichever galaxy an astronomer chooses, though, it will be made up of tens to hundreds of billions of stars. "The first step is choosing which stars to observe," Cordiner explains.

Cordiner's colleagues at Queen's University in Belfast, U.K., took the lead on finding good targets. They picked blue supergiants -- stars that are very large, very hot and very bright. Supergiants also burn very clean: unlike our sun and other cooler stars, they contribute little background clutter to the observations being made.

To look for DIBs, an astronomer points the telescope at a star and scans through a rainbow made up of thousands of wavelengths of light. This rainbow, or spectrum, is extended a bit beyond visible light, into the UV at the blue end and into the infrared at the red end.

DIBs are not defined by what astronomers see while doing this, but by what they don't see. The colors missing from the rainbow, marked by black stripes, are the ones of interest. Each one is a wavelength being absorbed by some kind of atom or molecule.

A DIB is one of these regions where the color is missing. But compared to the nice, neat "absorption lines" that are identified with atoms or simple molecules, a DIB is not well-behaved, which is why it stands out. "Astronomers were used to seeing quite sharp, narrow bands where typical atoms and molecules absorb," says Cordiner. "But DIBs are broad; that's why they are called 'diffuse.' Some DIBs have simple shapes and are quite smooth, but others have bumps and wiggles and may even be lopsided."

The mystery deepens

Over time, astronomers have been building up catalogs to show exactly which wavelengths are absorbed by all kinds of atoms and molecules. Each molecule has its own unique pattern, which can be used like a fingerprint: if a pattern found during an astronomical observation matches a pattern in one of the catalogs, the molecule can be identified.

It's a pretty straightforward concept. So, early researchers "would surely not have thought that the solution to the diffuse band problem would still be so elusive," wrote Peter Sarre in a 2006 review article about DIBs. Sarre, a professor of chemistry and molecular astrophysics at the University of Nottingham, U.K., supervised Cordiner's graduate-school work on DIBs.

The significance of the first DIBs, recorded in 1922 in Mary Lea Heger's Ph.D. thesis, was not immediately recognized. But once astronomers began systematic studies, starting with a 1934 paper by P. W. Merrill, they had every reason to believe the problem could be solved within a decade or two.

No such luck

More than 400 DIBs have been documented since then. But not one has been identified with enough certainty for astronomers to consider its case closed.

"With this many diffuse bands, you'd think we astronomers would have enough clues to solve this problem," muses Joseph Nuth, a senior scientist with the Goddard Center for Astrobiology who was not involved in this work. "Instead, it's getting more mysterious as more data is gathered."

Detailed analyses of the bumps and wiggles of the DIBs, suggest that the molecules which give rise to DIBs -- called "carriers" -- are probably large.

But like beauty, "large" is in the eye of the beholder. In this case, it means the molecule has at least 20 atoms or more. This is quite small compared to, say, a protein but huge compared to a molecule of carbon monoxide, a very common molecule in space.

Recently, though, more interest has been focused on at least one small molecule, a chain made from three carbon atoms and two hydrogen atoms (C3H2). This was tentatively identified with a pattern of DIBs.

Tenacious D

On the list of DIB-related suspects, all molecules have one thing in common: they are organic, which means they are built largely from carbon.
Carbon is great for building large numbers of molecules because it is available almost everywhere. In space, only hydrogen, helium and oxygen are more plentiful. Here on Earth, we find carbon in the planet's crust, the oceans, the atmosphere and all forms of life.
Likewise, astronomers "see DIBs pretty much in any direction we look," says Jan Cami, an astronomer at the University of Western Ontario, Canada. He has collaborated with Cordiner before but was not involved in this study. "And we see lots of DIBs."
Carbon is also great for building molecules in all kinds of configurations -- millions of carbon compounds have been identified -- and especially for building very stable molecules.
DIB carriers also seem to be quite stable. They survive the harsh physical conditions in the interstellar medium -- the material found in the space between the stars. They also hang tough in the Large Magellanic Cloud, where radiation levels are thousands of times stronger than in the Milky Way. In fact, says Cordiner, DIB carriers seem comfortable almost everywhere except in the clouds of dense gas where stars are born.
"The carriers are readily formed but not readily destroyed in a wide range of different environments," says Cordiner. "It's remarkable how tenacious these molecules really are."
In short, carriers are thought to be made of carbon, Cami says, "because it's a lot easier to build strong and stable molecules from carbon atoms than from other elements, such as silicon or sulfur. Using those elements rather than carbon would be like building a house from a bucket of sand while there's a huge pile of bricks at the construction site."
The top three carrier candidates are: chain-like molecules, like the one now tentatively associated with a pattern of DIBs; PAHs, which often come up in studies of how planets formed; and compounds related to fullerenes, the soccer-ball-shaped molecules also known as buckyballs.
"This list covers most types of carbon molecules," notes Cami. "Chains are essentially the one-dimensional carbon molecules, PAHs are the two-dimensional ones, and fullerene compounds are the three-dimensional ones."

Present and accounted for

In spite of the challenges of looking for DIBs in other galaxies, it's worth the effort to astronomers because they need to see what DIBs look like under different conditions.
Granted, conditions are not uniform everywhere within a galaxy. Some stars have planets near them; others don't. Between the stars, in the vast tracts of interstellar medium, the relative amounts of gas and dust floating around can be different from one region to the next. And the exact mixture of chemicals can vary a little from place to place.
"But being on Earth and looking at another object in the Milky Way is like being in the crowd at Times Square in New York City on New Year's Eve and trying to find your friend," explains Nuth. "It's much easier to spot the person if you are on a balcony rather than standing in the crowd yourself." Likewise, it's much easier to get a clear overview of a galaxy when you are outside of it.
In some respects, Andromeda and the Triangulum are similar to the Milky Way. All three are spiral galaxies that belong to a collection of more than 30 nearby galaxies called the Local Group. The Milky Way is the largest member of this group. Andromeda is the second-largest, and the Triangulum is third.
Like the Milky Way, Andromeda and the Triangulum are thought to be good places to synthesize large organic molecules, which is what DIBs carriers are thought to be. And yet, says Cordiner, "nobody knew until now whether DIBs actually existed in either galaxy."
The team found that, indeed, DIBs do exist in both places, and they are strong, which implies there are many carriers.
In the Milky Way, when researchers find strong DIBs, they tend to find a lot of dust, too. This makes sense, because whenever there's more raw material available to make DIBs carriers, there's also more available to make dust. The team found the same situation in Andromeda, Cordiner says.
Of greater interest in Andromeda was whether the strength of the DIBs was related to the amount of PAHs, which are high on the list of candidates for carriers. The researchers knew going into the study that PAHs are plentiful in Andromeda, as they are in the Milky Way.
"The details of the PAH population seem to be somewhat different in Andromeda, though," says Cami. "This makes it interesting to try and find out exactly what is different."

But after checking to see if the PAH levels were related to DIBs strength, "we didn't find any correlation between the two," Cordiner says. That finding doesn't rule out a connection, but it might shift more attention to chains of carbon atoms or to fullerene compounds.

The carriers are not pure, isolated fullerenes, says Cami, who led the team that first detected fullerenes in space. More likely, "atoms or molecules are either locked up in fullerene cages or attached to the outside surface, " he explains. "This might even hold for some of the other proposed molecules. For example, you could think of carbon chains dangling from other molecules or even from dust grains."

The more things change . . .

One big difference between the Milky Way and Andromeda is the number of massive young stars. The Milky Way has more than Andromeda. Because those young stars generate a lot of UV radiation, the Milky Way's interstellar medium has higher levels of this radiation than Andromeda's does.

More radiation means a harsher environment, so organic molecules should survive better in an environment with less radiation. In that sense, Andromeda should be more favorable for the carriers of DIBs and, in theory, should be able to boast more of them. But Cordiner and his colleagues found that the DIBs in Andromeda were only slightly stronger than those in the Milky Way, implying that Andromeda can only claim slightly more carriers.

The observations in the Triangulum add even more intrigue. There, the researchers found strong DIBs even though this galaxy differs in its metallicity, which is a measure of the availability of ingredients for making stars and planets.

The consistency from galaxy to galaxy is surprising, given how much the conditions are thought to vary among them. "But there are no detailed studies of Andromeda to tell us everything we want to know about conditions there," says Cordiner. "And even less is known about the Triangulum."

As is usually the case in cutting-edge astronomy, some assumptions had to be made, and a lot depends on how well those assumptions hold up as more information becomes available.

Meanwhile, researchers will try to learn everything they can about DIBs near and far and the organic molecules they represent. "If we're going to understand fully how interstellar chemistry works -- how stars and planets form," says Cordiner, "then we need a full understanding of the ingredients they use."

Story Source:

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

Journal Reference:

1. Martin A. Cordiner, Nick L. J. Cox, Christopher J. Evans, Carrie Trundle, Keith T. Smith, Peter J. Sarre, Karl D. Gordon. **A Survey of Diffuse Interstellar Bands in the Andromeda Galaxy: Optical Spectroscopy of M31 OB Stars**. *The Astrophysical Journal*, 2011; 726 (1): 39 DOI: 10.1088/0004-637X/726/1/39

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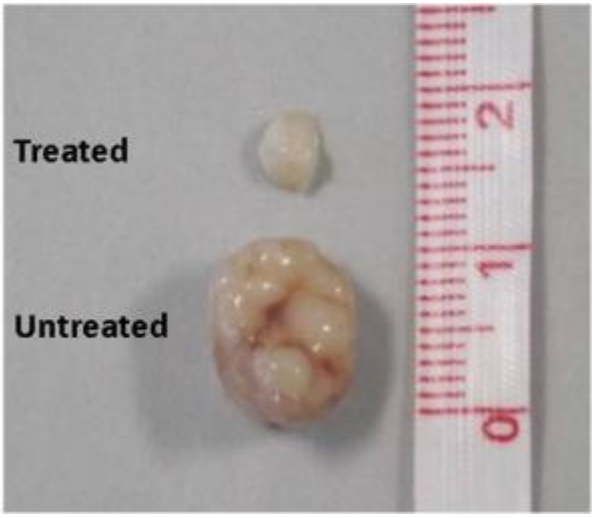
http://www.sciencedaily.com/releases/2011/01/110110154536.htm

Scientists Bring Cancer Cells Back Under Control



Tumor reduction. (Credit: Image courtesy of University of Nottingham)

ScienceDaily (Jan. 18, 2011) — Scientists at The University of Nottingham have brought cancer cells back under normal control -- by reactivating their cancer suppressor genes. The discovery could form a powerful new technology platform for the treatment of cancer of the breast and other cancers.

Breast cancer is diagnosed in about 1.4 million women throughout the world every year, with half a million dying from the disease. A common cause of cancer is when cells are altered or mutated and the body's tumour suppressor genes are switched off.

Research, published in the journal *Molecular Cancer*, reveals how Dr Cinzia Allegrucci from the School of Veterinary Science and Medicine and Dr Andrew Johnson in the Centre for Genetics and Genomics reactivated tumour suppressor genes and stopped the cancer from growing by treating them with Axolotl oocyte extract. After 60 days there was still no evidence of cancerous growth.

Cancers occur when the mechanisms that control normal cell division are mutated. The process of cell division is controlled by specific genes and these are turned "on" or "off" depending on their function. Among the most important of these genes are tumour suppressor genes. These genes repress the development of cancers and normally act as a control point in the cell division cycle. Therefore, the switching off of tumour suppressor genes is a common cause of cancers, including breast cancer.

Dr Allegrucci, a lecturer in molecular genetics and cell biology, said: "The on/off switch in genes is controlled by the modification of proteins that are bound to the DNA in a cell -- so called epigenetic modifications. Tumour suppressor genes in many breast cancers are switched off by epigenetic marks, which is the underlying cause of tumours. We sought to reverse this process, activating the tumour suppressor genes, in hope of stopping cancerous cell divisions."

Dr Johnson said: "To do this we used novel technology that makes use of the eggs of the axolotl salamander. Over the years Dr Johnson's lab has shown that humans evolved from animals that closely resemble axolotls, and because of this the proteins in axolotls are very similar to those in humans. Axolotl oocytes -- which are the eggs prior to ovulation -- are packed with molecules that have very powerful epigenetic modifying activity. Previously Johnson's lab showed that extracts prepared from these oocytes have powerful capacity to change epigenetic marks on the DNA of human cells.

And, in a breakthrough, they showed it is important to use oocytes from the ovary, because if the oocytes are ovulated these activities are lost. We thought that by treating cancer cells with extracts made from axolotl oocytes we could reverse the epigenetic marks on tumour suppressor genes, causing these genes to reactivate, and thereby stopping the cancerous cell growth."

The identification of the proteins responsible for this tumour reversing activity in axolotl oocytes is a major goal of future research which could form a powerful new technology platform for the treatment of cancers from the breast, and other tissues.

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

Journal Reference:

1. Cinzia Allegrucci, Michael D Rushton, James E Dixon, Virginie Sottile, Mansi Shah, Rajendra Kumari, Sue Watson, Ramiro Alberio and Andrew D Johnson. **Epigenetic reprogramming of breast cancer cells with oocyte extracts**. *Molecular Cancer*, 2011; 10: 7 DOI: 10.1186/1476-4598-10-7

http://www.sciencedaily.com/releases/2011/01/110118122554.htm

Keeping Your Digital Secrets Safe: Researchers Develop Security Application to Keep Private Data Private

ScienceDaily (Jan. 18, 2011) — Privacy in the digital age is a sensitive issue for both governments and individuals, as recent news about WikiLeaks and Facebook proved. A new research project at Tel Aviv University may better educate citizens of the virtual world about their privacy -- and even help Facebook users avoid truly embarrassing moments.

It's all about fine-tuning privacy settings based on user information and behavior, says Dr. Eran Toch of Tel Aviv University's Iby and Aladar Fleischman Faculty of Engineering. His software solution, Locacino, is based on better security design, and provides users with a higher degree of control over their privacy settings. It also provides a glimpse into how people really share information between friends over the Internet.

Facebook's privacy settings -- or the lack thereof -- can cost us relationships or a future job. But knowing how to fine-tune our settings can save a lot of future heartache, says Dr. Toch, whose research was recently presented at Ubicomp, a leading conference on mobile computing.

Guarding your "centers of privacy"

Dr. Toch's research began at Carnegie Mellon University in the U.S. and continues in Tel Aviv. In collaboration with Prof. Norman Sadeh, Prof. Lorrie Cranor, and Prof. Jason Hong, all from Carnegie Mellon University, School of Computer Science, he created Locacino, a location-sharing application that can capture end-user security and privacy preferences in mobile computing.

In most social applications, it's not easy to fine-tune privacy settings. Like FourSquare and Facebook "Places," Locacino allows its users to track their friends' physical location, but in Locacino, users can also see who is viewing their profiles and location updates, which may lead users to rethink and modify their privacy settings.

At Carnegie Mellon, he and his team conducted large experiments using the Locacino application that was downloaded to users' iPhones and Android phones. The unique mobile social network allows people to fine-tune the way they want their information about them to be presented online. Thousands of college students participated in the study.

Dr. Toch examined what kinds of location updates users are more likely to share, then determined the users' "centers of privacy." It turned out that young people guard locations that might reveal information about their social life more than anything else, even the location of their homes or dormitories.

Locacino's flexibility allows users to let their work colleagues know their physical location on weekdays, but not on weekends. "If a friend tags you on an iPhone when you're at a pub instead of at work, you have no control over work colleagues seeing that on Facebook. But if we give users more flexible privacy settings, they're actually willing to share even more information online," Dr. Toch reports.

A difference of culture

There are cultural differences in attitudes towards online privacy as well. Next, Prof. Toch will investigate online privacy among the Israeli Arab population, and he's already discovered differences between Americans and Israelis. Israelis, for instance, would never dream of blocking their parents from Facebook, but it's common in the United States -- especially when the kids are teenagers, he says.

When Locacino completes the development stage, Prof. Toch hopes that when it's widely available, it will allow users to rethink security and privacy in the digital world -- and give them the tools to better control it.

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

http://www.sciencedaily.com/releases/2011/01/110118113449.htm

Young Couples Can't Agree on Whether They Have Agreed to Be Monogamous

Couple on the beach. Couples become monogamous generally for emotional reasons, to show love and trust in a relationship. (Credit: iStockphoto/Kristian Sekulic)

ScienceDaily (Jan. 18, 2011) — While monogamy is often touted as a way to protect against disease, young couples who say they have discussed monogamy can't seem to agree on what they decided. And a significant percentage of those couples who at least agreed that they would be monogamous weren't.

A new study of 434 young heterosexual couples ages 18-25 found that, in 40 percent of couples, only one partner says the couple agreed to be sexually exclusive. The other partner said there was no agreement.

Public health researchers Jocelyn Warren and Marie Harvey of Oregon State University looked at data from the PARTNERS Project, a Center for Disease Control-funded study conducted by Harvey. The researchers said this study showed that many couples are misjudging their partners' risk behaviors.

The results are in a forthcoming article published online in the *Journal of Sex Research*.

"Other studies have looked at perceptions related to monogamy, but this is really the first one that explores the discussions that heterosexual couples are -- or aren't -- having about monogamy," Warren said. "Miscommunication and misunderstandings about sexual exclusivity appear to be common."

Previous research has shown that condom use tends to decline as relationships become more intimate and steady over time. Yet Warren and Harvey's study shows that some couples may not be communicating effectively on the terms of their relationship. Even among those who agreed they had an explicit agreement to be monogamous, almost 30 percent had broken the agreement, with at least one partner having had sex outside the relationship.

Harvey, a leading researcher in the field of sexual and reproductive health, said this study adds to a growing body of research on safer sex communication.

"Couples have a hard time talking about these sorts of issues, and I would imagine for young people it's even more difficult," she said. "Monogamy comes up quite a bit as a way to protect against sexually transmitted diseases. But you can see that agreement on whether one is monogamous or not is fraught with issues."

The couples surveyed included both married and non-married couples. Interestingly, couples with children were less likely to have a monogamy agreement in place. Married couples were no more likely to have an explicit monogamy agreement in place than other couples.

Only commitment was related to sustained monogamy. Relationship commitment was assessed using an accepted measurement scale where participants rated themselves from one to five (five being highest) on questions such as "You view your relationship as permanent." With every unit increase in the commitment scale, the odds that the couple had a sustained monogamy agreement increased almost three-fold.

"Relationship variables appear to be related to monogamy," Harvey said. "But factors such as marriage and children did not increase the likelihood that the couple had agreed to monogamy."

Warren said couples become monogamous generally for emotional reasons, to show love and trust in a relationship. Yet the concern is that a lack of communication between heterosexual couples is leading to unintended risks.

Harvey said the sexual behavior and protection of young couples is ripe for intervention. She recommends that those who work with young people in clinical and community settings ask what kind of protection they

are using. "And if they answer that their partner is monogamous, they may want to think about advising that young person to use protection," Harvey said.
Warren is a research associate at OSU and Harvey is a professor of public health at OSU. Christopher Agnew from Purdue University contributed to this study.

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

Journal Reference:

1. Jocelyn Warren, S. Marie Harvey, Christopher Agnew. **One Love: Explicit Monogamy Agreements among Heterosexual Young Adult Couples at Increased Risk of Sexually Transmitted Infections**. *Journal of Sex Research*, 2010; : 1 DOI: 10.1080/00224499.2010.541952

http://www.sciencedaily.com/releases/2011/01/110118123554.htm

Obesity in Horses Could Be as High as in Humans

University of Nottingham Vet School student Helen Stephenson. (Credit: Image courtesy of University of Nottingham)

ScienceDaily (Jan. 18, 2011) — At least one in five horses used for leisure are overweight or obese. It's a condition which can lead to laminitis and equine metabolic syndrome.

The pilot study, carried out by The University of Nottingham's School of Veterinary Medicine and Science, showed that rates of obesity among horses are likely to be just as high as they are among people. The results are published online in the journal *Veterinary Record*.

The study, by third year veterinary student Helen Stephenson from Lydney in Gloucestershire, assessed the prevalence of obesity among horses whose owners were registered with Oakham Veterinary Hospital -- one of the school's clinical associates specialising in the treatment of horses.

Research carried out in Scotland has already shown a prevalence of obesity in pleasure riding horses but this is the first time a similar study has been done in England.

Five hundred owners were sent questionnaires. None of them kept horses for breeding, livery, riding stables, or competition, so were all classed as keeping their animals for leisure only. Of the 160 returned one in five showed that their horses were either overweight or obese.

The research was supervised by Dr Sarah Freeman, a specialist in Veterinary Surgery at the vet school. Dr Freeman said: "This provides the first snapshot of the prevalence of obesity in horses in the UK and an insight into owners' management of bodyweight in horses. Obesity is linked to a number of different diseases, including arthritis, laminitis and equine metabolic syndrome. A larger study would be useful to establish the prevalence and risk factors for equine obesity in different horse populations across the UK."

The owners were asked about their perceptions of their horses' body condition, and asked to score this from zero to five, with a score of more than 3 indicating overweight.

Grass was the main source of forage for half the horses and coarse mix was the main source of concentrate feed in a similar proportion. Only one in 10 horses was not fed any concentrate.

The researchers then assessed the body condition of 15 randomly selected horses to see if the scores had under or overestimated the horse's weight.

They assigned an average score that was significantly higher for these horses; eight of the owners had scored their horse at least one grade lower than the researcher had, indicating that the owners had underestimated their horses' weight.

On the basis of the researchers' findings, the authors estimate that the true prevalence of overweight/obesity was likely to be 54% rather than the 20% indicated by the questionnaire responses.

Increasing incidence of obesity is a multi-species problem, affecting both humans and their companion animals. I feel that addressing this issue is an important role for the profession, and I hope to do my part when I go into practice.
Helen said: "Increasing incidence of obesity is a multi-species problem, affecting both humans and their companion animals. I feel that addressing this issue is an important role for the profession, and I hope to do my part when I go into practice."

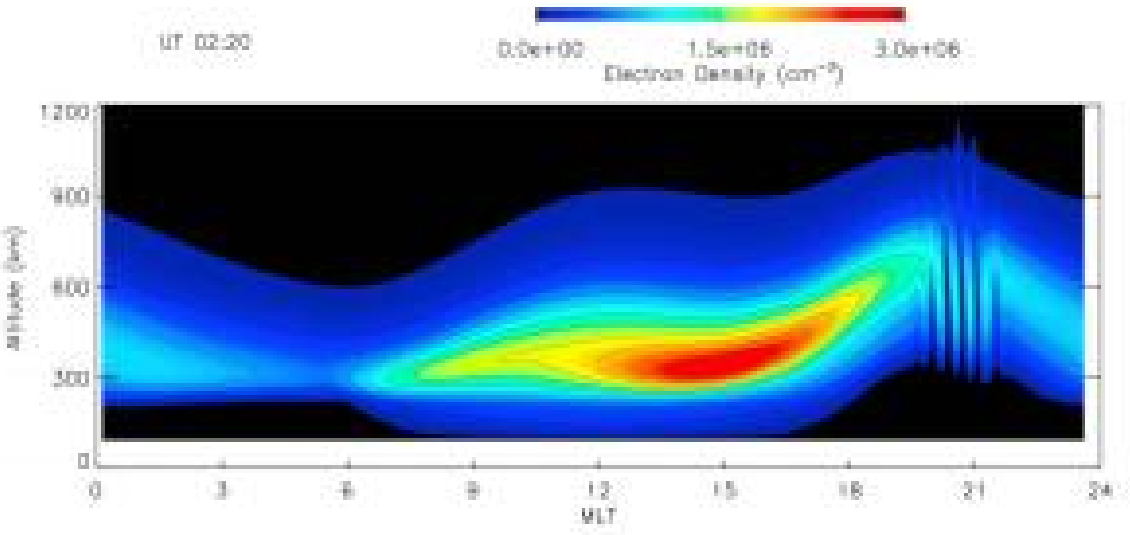
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Nottingham**.

Journal Reference:

1. H. M. Stephenson, M. J. Green, S. L. Freeman. **Prevalence of obesity in a population of horses in the UK**. *Veterinary Record*, 2011; DOI: 10.1136/vr.c6281

http://www.sciencedaily.com/releases/2011/01/110118122558.htm

Scientists Develop 3-D Model of the Ionosphere F-Region



Contour plot of the electron density as a function of magnetic local time (MLT) and altitude. A fully 3D spatial model of ESF describing the motion of ions along and transverse to the geomagnetic field in a narrow longitudinal wedge of the post-sunset ionosphere. (Credit: U.S. Naval Research Laboratory, 2010)
ScienceDaily (Jan. 18, 2011) —

The first global simulation study of equatorial spread *F* (ESF) bubble evolution using a comprehensive 3D ionosphere model, SAMI3, has been demonstrated. The model self-consistently solves for the neutral wind driven dynamo electric field and the gravity driven electric field associated with plasma bubbles.

Developed by Dr. Joseph Huba and Dr. Glenn Joyce at the NRL Plasma Physics Division, SAMI3 is a fully three-dimensional model of the low- to mid-latitude ionosphere. SAMI3 has been modified recently to use a sun-fixed coordinate system to eliminate rotation of the dawn-dusk line and a high-resolution longitudinal grid to capture the evolution of equatorial plasma bubbles in the pre- to post-sunset sector.

The new modeling capability with SAMI3 has found that ESF can be triggered by pre-sunset ionospheric density perturbations and that an existing ESF plasma bubble can trigger a new bubble.

"Understanding and modeling ESF is important because of its impact on space weather," said Dr. Joseph Huba, head of the Space Plasma Physics Section of the Beam Physics Branch. "ESF anomalies can cause radio wave scintillation that degrades communication and navigation systems and serves as the primary focus of the Air Force Communications/ Navigation Outage Forecast System.

Post-sunset ionospheric irregularities in the equatorial *F*-region were first observed in 1938 by terrestrial magnetism researchers, H.G. Booker and H.W. Wells at the Carnegie Institution of Washington. During that time, analysis of the scattering of radio waves by the *F*-region of the ionosphere at an equatorial location (Huancayo, Peru) revealed ESF is fundamentally a nighttime event, with greatest frequency of occurrence in the period from four hours before midnight to four hours after midnight.

"The ionosphere builds up after sunrise and reaches a maximum electron density in mid-afternoon, said Huba. "Subsequently, the ionosphere can be lifted to higher altitudes just after sunset because of the pre-reversal enhancement of the eastward electric field. During this time the ionosphere can become unstable."

The *F*-region of the ionosphere is home to the *F*-layer, or Appleton layer, and is the densest part of the ionosphere as it extends from about 200 km to more than 500 km above the surface of Earth. Beyond this layer is the topside ionosphere. Here extreme ultraviolet solar radiation ionizes atomic oxygen. The *F*-layer consists of one layer at night, but during the day, a deformation often forms creating layers labeled F_1 and F_2 . The *F*-region is the region of the ionosphere that is very important for high-frequency (HF) radio wave propagation facilitating HF radio communications over long distances.

The upgraded version of SAMI3 represents a unique resource to investigate the physics of equatorial spread *F*, particularly the processes that control the day-to-day variability of ESFs. Future improvements to the current model include: modification to the geomagnetic field to have a tilt allowing the inclusion of longitudinal effects; coupling SAMI3 with a physics-based model of the thermosphere; and replacement of the full donor cell algorithm, currently being used for crossfield transport, with a high-order flux transport algorithm allowing for the capture of complex bubble evolution involving bifurcation.

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Naval Research Laboratory**.

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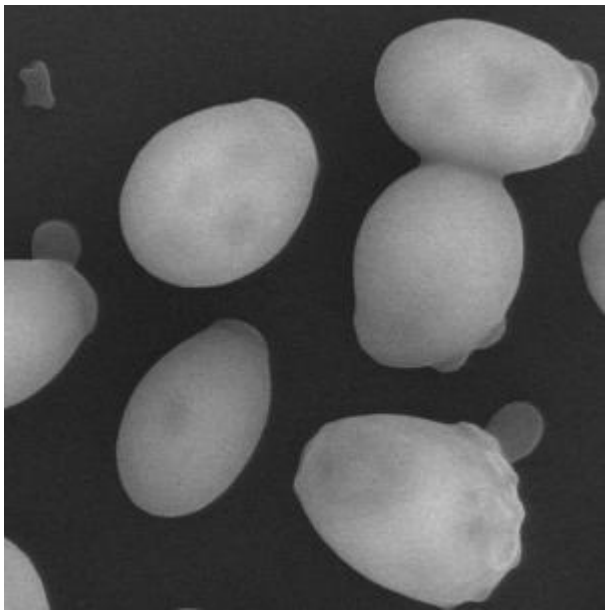
http://www.sciencedaily.com/releases/2011/01/110118113138.htm

New Hope in Fight Against Huntington's Disease



Visualisation of individual baker's yeast cells (Saccharomyces cerevisiae) by scanning electron microscopy. (Credit: University of Leicester)

ScienceDaily (Jan. 18, 2011) — Hope for new ways of treating devastating neurodegenerative disorders such as Huntington's disease has been raised by a trans-Atlantic team of researchers thanks to the use of cutting-edge genetic techniques.

Led by the University of Leicester, scientists from the University of Lisbon (led by Dr Tiago Outeiro) and University of California at San Francisco (led by Dr Paul Muchowski) collaborated to generate novel approaches for tackling the diseases. Their work, funded by the Medical Research Council, is published in the *Journal of Biological Chemistry.*

At Leicester, working simply with baker's yeast, a team of biological scientists examined aspects of Huntington's disease. These yeast are extremely well-characterised and have powerful and facile genetics which allow researchers to rapidly interrogate this system at a genome-wide level. Research in recent years has found that baker's yeast can be used to study mechanisms underlying disease pathology, and this simple organism has been used to identify several promising candidate drug targets for neurodegenerative disorders, including Huntington's disease.

Flaviano Giorgini, lead author of the research paper at the University of Leicester, said: "My research group is interested in using genetics and genomics approaches to better understand the fatal neurodegenerative disorders of Huntington's disease and Parkinson's disease.

"By clarifying the genes and cellular pathways involved in these diseases we hope to identify novel strategies for treatment and therapy of these disorders. In our work we use simple, yet powerful genetic organisms such as baker's yeast and fruit flies to model aspects of these devastating diseases.

"In the current study we have used a novel functional genomics profiling approach to identify genes which can protect these simple organisms from disease symptoms. We then used computational approaches to uncover a network of interactions amongst these genes, which has shed light on the mechanisms underlying this disorder."

Using the approach above, the scientists found that many of the protective genes are involved in translation -- a cellular process in which messenger RNA (mRNA) is decoded by the ribosome to produce specific proteins. This is particularly intriguing as this process has not been implicated in Huntington's disease in the past.

This is important because recent work indicates that pharmacological modulation of translation may represent a promising avenue for treatment of Parkinson's disease. Therefore, this new research strongly dovetails with these observations and suggests that similar drug treatment may be beneficial in Huntington's disease.

Dr Giorgini, of the Department of Genetics, said: "Our research has taken advantage of cutting edge genomics approaches using a simple model organism to identify a novel area for potential therapeutic intervention for Huntington's disease.
"If our findings are validated by further studies, it might suggest a novel therapeutic approach for this devastating disorder -- which is critical as currently there are no treatments for onset or progression of symptoms."

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

Journal Reference:

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http://www.sciencedaily.com/releases/2011/01/110110070051.htm

Big Breakfast Generally Doesn't Help Weight Loss

ScienceDaily (Jan. 18, 2011) — Does eating a big breakfast help weight loss or is it better to skip breakfast altogether? Available information is confusing but new research published in BioMed Central's open access journal *Nutrition Journal* clears a path through these apparently contradictory reports.

Dr Volker Schusdziarra, from the Else-Kröner-Fresenius Center of Nutritional Medicine, conducted a study on over 300 people who were asked to keep a journal of what they usually ate. Within the group sometimes people ate a big breakfast, sometimes small, and sometimes skipped it all together.

Schusdziarra said that "the results of the study showed that people ate the same at lunch and dinner, regardless of what they had for breakfast," this means that a big breakfast (on average 400kcal greater than a small breakfast) resulted in a total increase in calories eaten over the day of about 400kcal. The only difference seen was the skipping of a mid morning snack when someone ate a really big breakfast, however this was not enough to offset the extra calories they had already eaten.

The group addressed previous research, which suggests that eating a big breakfast reduces total calorie intake over the day, and showed that this data is misleading. This earlier research only looked at the ratio of breakfast calories to daily calories and in Schusdziarra's study this ratio seems to be most affected by people eating less during the day. In other words their breakfast was proportionally, but not absolutely, bigger. So it seems that there is no magic and that, unfortunately, in the fight for weight-loss, eating a large breakfast must be counteracted by eating substantially less during the rest of the day.

In order to lose weight sensibly NHS guidelines (UK) suggest restricting calorie intake, cutting down on saturated fat and sugar, and eating 5-a-day fruit and veg.

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

Journal Reference:

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http://www.sciencedaily.com/releases/2011/01/110116214608.htm

Gene Helps Plants Use Less Water Without Biomass Loss

California, USA. Purdue University researchers have found a genetic mutation that allows a plant to better endure drought without losing biomass, a discovery that could reduce the amount of water required for growing plants and help plants survive and thrive in adverse conditions. (Credit: Copyright Michele Hogan)

ScienceDaily (Jan. 18, 2011) — Purdue University researchers have found a genetic mutation that allows a plant to better endure drought without losing biomass, a discovery that could reduce the amount of water required for growing plants and help plants survive and thrive in adverse conditions.

Plants can naturally control the opening and closing of stomata, pores that take in carbon dioxide and release water. During drought conditions, a plant might close its stomata to conserve water. By doing so, however, the plant also reduces the amount of carbon dioxide it can take in, which limits photosynthesis and growth.

Mike Mickelbart, an assistant professor of horticulture; Mike Hasegawa, a professor of horticulture; and Chal Yul Yoo, a horticulture graduate student, found that a genetic mutation in the research plant *Arabidopsis thaliana* reduces the number of stomata. But instead of limiting carbon dioxide intake, the gene creates a beneficial equilibrium.

"The plant can only fix so much carbon dioxide. The fewer stomata still allow for the same amount of carbon dioxide intake as a wild type while conserving water," said Mickelbart, whose results were published in the early online version of the journal *The Plant Cell*. "This shows there is potential to reduce transpiration without a yield penalty."

Mickelbart and Yoo used an infrared gas analyzer to determine the amount of carbon dioxide taken in and water lost in the *Arabidopsis* mutant. Carbon dioxide is pumped into a chamber with the plant and the analyzer measures the amount left after a plant has started to take up the gas. A similar process measures water lost through transpiration, in which water is released from a plant's leaves.

Analysis showed that the plant, which has a mutant form of the gene *GTL1*, did not reduce carbon dioxide intake but did have a 20 percent reduction in transpiration. The plant had the same biomass as a wild type of *Arabidopsis* when its shoot dry weight was measured.

"The decrease in transpiration leads to increased drought tolerance in the mutant plants," Yoo said. "They will hold more water in their leaves during drought stress."

Of the 20 genes known to control stomata, *SDD1* was highly expressed in the mutant. *SDD1* is a gene that is responsible for regulating the number of stomata on leaves. In the mutant, with *GTL1* not functioning, *SDD1* is highly expressed, which results in the development of fewer stomata.

Mickelbart said the finding is important because it opens the possibility that there is a natural way to improve crop drought tolerance without decreasing biomass or yield. He said the next step in the research is to determine the role of *GTL1* in a crop plant.

The National Science Foundation and a Binational Agricultural Research and Development Award funded the research.

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

Journal Reference:

1. C. Y. Yoo, H. E. Pence, J. B. Jin, K. Miura, M. J. Gosney, P. M. Hasegawa, M. V. Mickelbart. **The Arabidopsis GTL1 Transcription Factor Regulates Water Use Efficiency and Drought Tolerance by Modulating Stomatal Density via Transrepression of SDD1**. *The Plant Cell Online*, 2010; DOI: 10.1105/tpc.110.078691

http://www.sciencedaily.com/releases/2011/01/110111141347.htm

Minimally Invasive Technique Appears Helpful to Reanimate Facial Paralysis

ScienceDaily (Jan. 18, 2011) — A procedure involving only one small incision and no major modifications to bone can be used to transpose a tendon and appears helpful in reanimating the lower face after paralysis, according to a report in the January/February issue of *Archives of Facial Plastic Surgery*, one of the JAMA/Archives journals.

"The primary goal of all facial reanimation protocols is to restore facial movement that is controlled, symmetrical and spontaneous," the authors write as background information in the article. Previously, researchers reported a method of transferring the temporalis tendon -- a tendon attached to the temporalis muscle, a large fan-shaped muscle on the side of the head -- to reanimate the face. The procedure involved an incision at the temple and surgical dissection of the temporalis muscle.

Kofi D. Boahene, M.D., and colleagues at the Johns Hopkins University School of Medicine, Baltimore, report a case series of 17 consecutive patients with facial paralysis who underwent a minimally invasive temporalis tendon transposition procedure between 2006 and 2008. The technique now involves only one small incision, and the tendon is accessed through the skin folds on the side of the nose or through the mouth.

"All the patients tolerated the procedure well, and none developed procedure-related complications," the authors write. "All the patients achieved improved symmetry at rest and voluntary motion of the oral commissure [corners of the mouth]."

With this technique, directed physical therapy is necessary to achieve the best outcome, the authors note. "The visible movement gained from dynamic muscle transposition does not translate into a spontaneous controlled smile without intensive neuromuscular retraining," they write. The patient first learns and practices a "Mona Lisa" smile, in which the corners of the mouth are elevated but not the upper or lower lip. They then learn to smile by contracting the temporal muscle without moving the jaw.

"Dynamic reanimation after facial paralysis remains challenging but can be achieved in selected patients using the minimally invasive temporalis tendon transposition (MIT3)," the authors conclude. "Although the technique is straightforward and dynamic movement can be demonstrated with intraoperative muscle stimulation, acquisition of desired facial movement requires intensive physiotherapy and a motivated patient."

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **JAMA and Archives Journals**.

Journal Reference:

1. Kofi D. Boahene, Tarik Y. Farrag, Lisa Ishii, Patrick J. Byrne. **Minimally Invasive Temporalis Tendon Transposition**. *Archives of Facial Plastic Surgery*, 2011;13(1):8-13 DOI: 10.1001/archfacial.2010.100

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New Molecular Imaging Technologies for Detecting Cellular Processes

A group of researchers at Universidad Carlos III de Madrid (UC3M) have designed and developed a biomedical scanner that detects cellular processes at the molecular level and indicates malfunctioning of an organ before said malfunction can produce an anatomical change. (Credit: Image courtesy of Carlos III University of Madrid)

ScienceDaily (Jan. 18, 2011) — A group of researchers at Universidad Carlos III de Madrid (UC3M) has designed and developed a biomedical scanner that detects cellular processes at the molecular level and indicates malfunctioning of an organ before said malfunction can produce an anatomical change.

The work carried out by these scientists has ranged from the initial design of an electronic architecture for gamma ray detectors to industry transfer of a complete scanner, after having adequately validated a prototype through experimental studies at the Gregorio Marañón Hospital. The results of this research, headed by professors Juan José Vaquero and Manuel Desco, from the Department of de Bioengineering and Aerospace Engineering at UC3M, have been recently published in the journals *IEEE Transactions on Nuclear Science* (two articles) and *Physics in Medicine and Biology* (one article).

The electronic technology equipment designed by the researchers- which is in patent process-is based on molecular imaging, a type of biomedical imaging capable of detecting live cellular processes. "These techniques differ from conventional medical imaging in that the information they show is *function* not *form*, which means that they are capable of showing the malfunctioning of an organ before the malfunction turns into an anatomical change," Juan José Vaquero explained. "In other words," he added, "they allow for earlier detection of a possible anomaly, which enormously facilitates treatment." In addition to making an earlier diagnosis possible these types of scanners are used in biomedical research and in pharmaceutical laboratories, for example, to speed up the development of new medicines

The growth of molecular imaging in recent years, according to experts, is chiefly due to the narrowing of the gap between molecular biology and imaging technologies, and it is expected that an acceleration of the transfer of these techniques to clinical practice will be produced. In fact, some of the characteristics of molecular imaging itself are already present in techniques for clinical use in humans such as nuclear medicine imaging or magnetic resonance imaging. "Computerized tomograhy by a sole photon emission, better known

by its Anglo-Saxon acronym SPECT, is probably the most widespread molecular imagining technique in clinical practice, and from there stems the interest in having preclinical systems which allow the study of human illnesses to be carried out on animals," Professor Manuel Desco pointed out.
The Department of Bioengineering and Aerospace Engineering at UC3M focuses on the development of preclinical molecular imaging scanners used in research work on animals. Obtaining good quality in these applications constitutes a much more difficult technical challenge than with humans, due to the large difference in size (with animals being approximately 280 times smaller). The research group has completed the development of SPECT type of system for laboratory animals at University installation, which has features placing it among the top on an international scale in terms of facilities and cost.
This UC3M research group, in addition to carrying out research which leads to scientific publications, focuses a large part of its interest on technology transfer so that it can be commercialized. The company, SEDECAL, the largest domestic manufacturer and exporter of electro-medical imaging equipment, is going to commercialize the system in the immediate future. The research team from this Madrid public university continues to work on new developments in the area of technology, in close contact with national industry. Part of the developments are under the framework of the AMIT (*Advanced Molecular Imaging Technologies*) Project from the most recent CENIT public funding, whose scientific coordination oversees this equipment at the UC3M.

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

Journal References:

1. Juan J. Vaquero, José M. Udías, Jurgen Seidel, Samuel España, Manuel Desco Magazine:. **Effects of the Super Bialkali Photocathode on the Performance Characteristics of a Position-Sensitive Depth-of-Interaction PET Detector Module**. *IEEE TRANSACTIONS ON NUCLEAR SCIENCE*, Vol. 57, N. 5, OCTOBER 2010, pp 2437-2441
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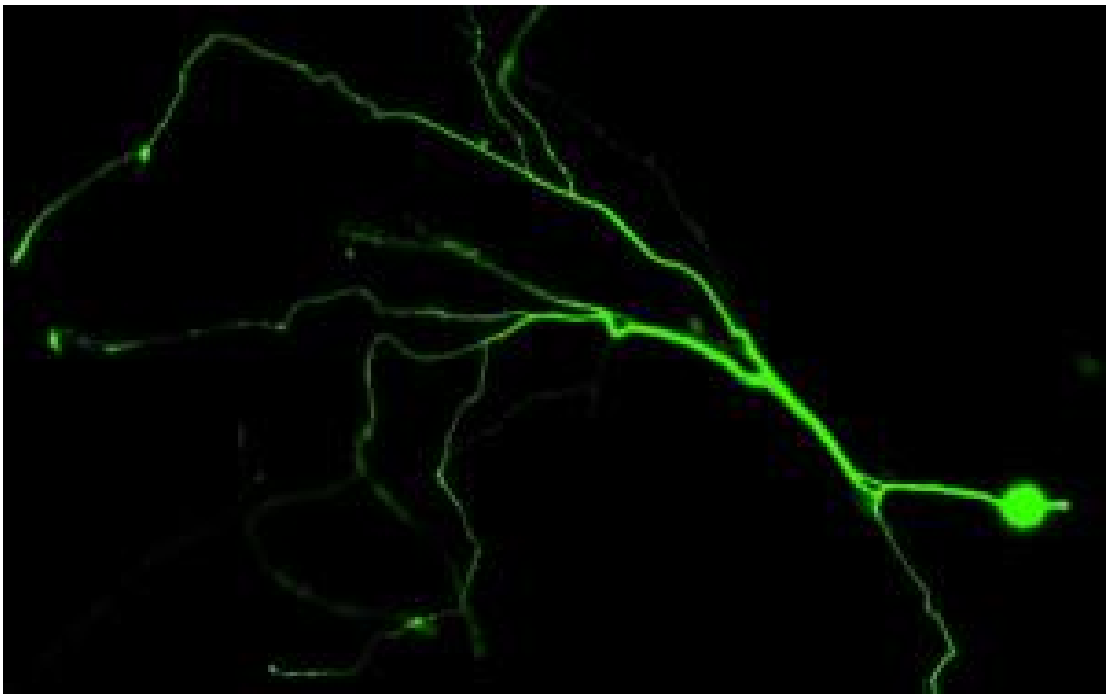
http://www.sciencedaily.com/releases/2011/01/110111132715.htm

New Molecule Could Save Brain Cells from Neurodegeneration, Stroke



A fluorescently labeled neuron in which the apoptosis pathway is inhibited. (Credit: Deshmukh lab, UNC)

ScienceDaily (Jan. 18, 2011) — Researchers at the University of North Carolina at Chapel Hill have discovered a molecule that can make brain cells resistant to programmed cell death or apoptosis.

This molecule, a tiny strand of nucleotides called microRNA-29 or miR-29, has already been shown to be in short supply in certain neurodegenerative illnesses such as Alzheimer's disease and Huntington's disease. Thus, the discovery could herald a new treatment to prompt brain cells to survive in the wake of neurodegeneration or acute injury like stroke.

"There is the real possibility that this molecule could be used to block the cascade of events known as apoptosis that eventually causes brain cells to break down and die," said senior study author Mohanish Deshmukh, PhD, associate professor of cell and developmental biology.

The study, published online Jan. 18, 2011, in the journal *Genes & Development*, is the first to find a mammalian microRNA capable of stopping neuronal apoptosis.

Remarkably, a large number of the neurons we are born with end up dying during the normal development of our bodies. Our nerve cells must span great distances to ultimately innervate our limbs, muscles and vital organs. Because not all nerve cells manage to reach their target tissues, the body overcompensates by sending out twice as many neurons as required. The first ones to reach their target get the prize, a cocktail of factors needed for them to survive, while the ones left behind die off. Once that brutal developmental phase is over, the remaining neurons become impervious to apoptosis and live long term.

But exactly what happens to suddenly keep these cells from dying has been a mystery. Deshmukh thought the key might lie in microRNAs, tiny but powerful molecules that silence the activity of as many as two-thirds of all human genes. Though microRNAs have been a hotbed of research in recent years, there have been relatively few studies showing that they play a role in apoptosis. So Deshmukh and his colleagues decided to look at all of the known microRNAs and see if there were any differences in young mouse neurons versus mature mouse neurons.

One microRNA jumped out at them, an entity called miR-29, which at that time had never before been implicated in preventing apoptosis. When the researchers injected their new molecule into young neurons, which are able to die if instructed, they found that the cells became resistant to apoptosis, even in the face of multiple death signals.

They then decided to pinpoint where exactly this molecule played a role in the series of biochemical events leading to cell death. The researchers looked at a number of steps in apoptosis and found that miR-29 acts at a key point in the initiation of apoptosis by interacting with a group of genes called the BH3-only family. Interestingly, the microRNA appears to interact with not just one but as many as five members of that family, circumventing a redundancy that existed to allow cell death to continue even if one of them had been blocked. "People in the field have been perplexed that when they have knocked-out any one of these members it hasn't had a remarkable effect on apoptosis because there are others that can step in and do the job," said Deshmukh. "The fact that this microRNA can target multiple members of this family is very interesting because it shows how a single molecule can basically in one stroke keep apoptosis from happening. Interestingly, it only targets the members that are important for neuronal apoptosis, so it may be a way of specifically preserving cells in the brain without allowing them to grow out of control (and cause cancer) elsewhere in the body."
Deshmukh is currently developing mouse models where miR-29 is either "knocked-out" or overactive and plans to cross them with models of Alzheimer's disease, Parkinson's disease and ALS to see if it can prevent neurodegeneration. He is also actively screening for small molecule compounds that can elevate this microRNA and promote neuronal survival.
The research was funded by the National Institutes of Health. Study co-authors were Adam J. Kole, a graduate student in Deshmukh's lab; Vijay Swahari, research technician; and Scott M. Hammond, PhD, associate professor of cell and developmental biology.

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

Journal Reference:

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http://www.sciencedaily.com/releases/2011/01/110118122740.htm

Apologies Aren't as Good as People Imagine They'll Be

ScienceDaily (Jan. 18, 2011) — We all want an apology when someone does us wrong. But a new study, published in *Psychological Science,* a journal of the Association for Psychological Science, finds that people aren't very good at predicting how much they'll value an apology.

Apologies have been in the news a lot the last few years in the context of the financial crisis, says David De Cremer of Erasmus University in the Netherlands. He cowrote the study with Chris Reinders Folmer of Erasmus University and Madan M. Pillutla of London Business School. "Banks didn't want to apologize because they didn't feel guilty but, in the public eye, banks were guilty," De Cremer says. But even when some banks and CEOs did apologize, the public didn't seem to feel any better. "We wondered, what was the real value of an apology?"

De Cremer and his colleagues used an experiment to examine how people think about apologies. Volunteers sat at a computer and were given 10 euros to either keep or give to a partner, with whom they communicated via computer. The money was tripled so that the partner received 30 euros. Then the partner could choose how much to give back -- but he or she only gave back five euros. Some of the volunteers were given an apology for this cheap offer, while others were told to imagine they'd been given an apology.

The people who imagined an apology valued it more than people who actually received an apology. This suggests that people are pretty poor forecasters when it comes down to what is needed to resolve conflicts. Although they want an apology and thus rate it as highly valuable, the actual apology is less satisfying than predicted.

"I think an apology is a first step in the reconciliation process," De Cremer says. But "you need to show that you will do something else." He and his authors speculate that, because people imagine that apologies will make them feel better than they do, an apology might actually be better at convincing outside observers that the wrongdoer feels bad than actually making the wronged party feel better.

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

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http://www.sciencedaily.com/releases/2011/01/110118154735.htm

Antioxidants Cause Fertility Problems in Females, Scientists Discover

ScienceDaily (Jan. 18, 2011) — Antioxidants are sold over the counter everywhere. They're added to food, drink and face cream. But according to Prof. Nava Dekel of the Biological Regulation Department, we still don't have a complete understanding of how they act in our bodies. New research by Dekel and her team, recently published in the *Proceedings of the National Academy of Sciences (PNAS)*, has revealed a possible unexpected side effect of antioxidants: They might cause fertility problems in females.

Common antioxidants include vitamins C and E. These work by eliminating molecules called reactive oxygen species that are produced naturally in the body. Stress can cause these chemically active molecules to be overproduced; in large amounts they damage cells indiscriminately. By neutralizing these potentially harmful substances, antioxidants may, theoretically, improve health and slow down the aging process.

But when Dekel and her research team including her former and present Ph.D. students Dr. Ketty Shkolnik and Ari Tadmor applied antioxidants to the ovaries of female mice, the results were surprising: ovulation levels dropped precipitously. That is, very few eggs were released from the ovarian follicles to reach the site of fertilization, compared to those in untreated ovaries.

To understand what lies behind these initial findings, the team asked whether it is possible that the process of ovulation might rely on the very 'harmful' substances destroyed by antioxidants -- reactive oxygen species. Further testing in mice showed that this is, indeed, the case. In one experiment, for instance, Dekel and her team treated some ovarian follicles with luteinizing hormone, the physiological trigger for ovulation, and others with hydrogen peroxide, a reactive oxygen species. The results showed hydrogen peroxide fully mimicked the effect of the ovulation-inducing hormone. This implies that reactive oxygen species that are produced in response to luteinizing hormone serve, in turn, as mediators for this physiological stimulus leading to ovulation.

Among other things, these results help fill in a picture that has begun to emerge in recent years of fertility and conception, in which it appears that these processes share a number of common mechanisms with inflammation. It makes sense, says Dekel, that substances which prevent inflammation in other parts of the body might also get in the way of normal ovulation, and so more caution should be taken when administering such substances.

Much of Dekel's research has focused on fertility -- her previous results are already helping some women become pregnant. Ironically, the new study has implications for those seeking the opposite effect. Dekel: "On the one hand, these findings could prove useful to women who are having trouble getting pregnant. On the other, further studies might show that certain antioxidants might be effective means of birth control that could be safer than today's hormone-based prevention."

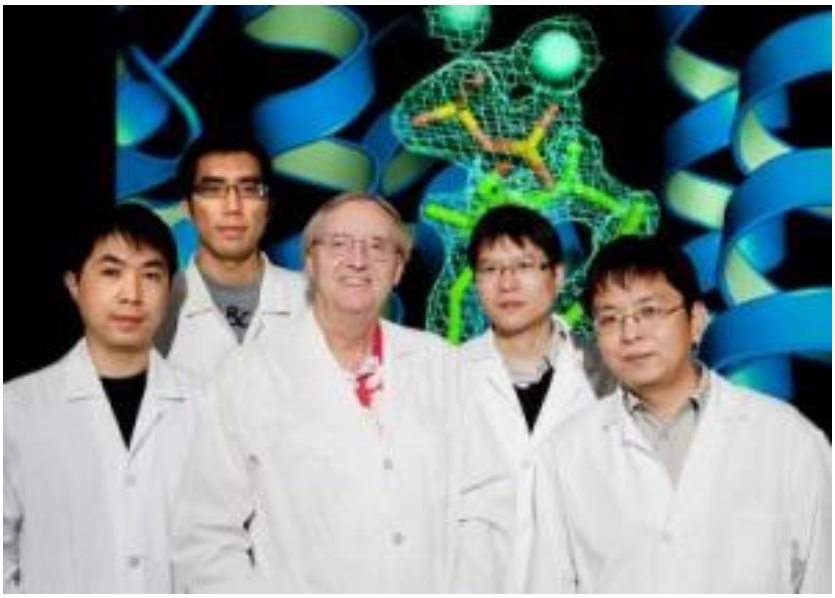
Dekel and her team are now planning further studies to investigate the exact mechanics of this step in ovulation and to examine its effect on mice when administered in either food or drink. In addition, they plan to collect data on the possible link between females being administered antioxidant supplements and the difficulty to conceive.

Prof. Nava Dekel's research is supported by the M.D. Moross Institute for Cancer Research; the Jeanne and Joseph Nissim Foundation for Life Sciences Research; the Yeda-Sela Center for Basic Research; the Willner Family Center for Vascular Biology -- Head; the Dwek Family Biomedical Research Fund; the Phyllis and Joseph Gurwin Fund for Scientific Advancement; and the J & R Foundation. Prof. Dekel is the incumbent of the Philip M. Klutznick Professorial Chair of Developmental Biology.

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

http://www.sciencedaily.com/releases/2011/01/110118101342.htm

Chemists Document Workings of Key Staph Enzyme -- And How to Block It



Chemists led by Illinois professor Eric Oldfield, center, determined the structure of a key enzyme that could lead to more efficient drugs to treat staph infections, parasites and high cholesterol. The research team, from left, research scientist Yonghui Zhang, graduate student Fu-Yang Lin, research scientist Rong Cao and postdoctoral associate Ke Wang. (Credit: L. Brian Stauffer)

ScienceDaily (Jan. 18, 2011) — Researchers have determined the structure and mechanism of an enzyme that performs the crucial first step in the formation of cholesterol and a key virulence factor in staph bacteria.

Chemists at the University of Illinois and collaborators in Taiwan studied a type of enzyme found in humans, plants, fungi, parasites, and many bacteria that begins the synthesis of triterpenes -- one of the most abundant and most ancient classes of molecules. Triterpenes are precursors to steroids such as cholesterol.

"These enzymes are important drug targets," said chemistry professor Eric Oldfield, who co-led the study. "Blocking their activity can lead to new cholesterol-lowering drugs, antibiotics that cure staph infections, and drugs that target the parasites that cause tropical maladies such as Chagas disease -- a leading cause of sudden death in Latin America."

For the study, the team picked a representative enzyme, dehydrosqualene synthase (CrtM), from the Staphylococcus aureus bacterium. Staph is one of the most common, yet notoriously hard to kill, bacterial infections. A key reason for staph's resilience is a golden-colored coating called staphyloxanthin that protects it from the body's immune system. CrtM catalyzes the first reaction in making staphyloxanthin, so inhibiting it would strip the bacteria of their protective coats and leave them vulnerable to attack by white blood cells.

The researchers already knew what CrtM looked like and its end product, but they didn't know how the enzyme did its job. Uncovering the mechanism of action would enable scientists to design better inhibitors, and even tailor them to other targets.

The team crystallized the enzyme and soaked it with intermediates and inhibitors. They then studied the complex structures by X-ray crystallography using the synchrotron at the Advanced Photon Source at Argonne National Laboratory.

They found that CrtM performs a two-step reaction, individually removing two diphosphate groups from the substrate. The substrate switches between two active sites within the enzyme as the reaction progresses. The most effective inhibitors bind to both sites, blocking the enzyme from any action.

"The leads that people have been developing for treating these diseases really haven't had any structural basis," said Oldfield, also a professor of biophysics. "But now that we can see how the protein works, we're in

a much better position to design molecules that will be much more effective against staph infections and parasitic diseases, and potentially, in cholesterol-lowering."
The researchers' inhibitor technologies have been licensed to AuricX Pharmaceuticals, which recently received a grant from the Texas Emerging Technology Fund for preclinical testing in staph infections.
The team published its work in the *Proceedings of the National Academy of Sciences*. The work was sponsored by the National Institutes of Health and the National Science Council. Co-authors were U. of I. graduate students Fu-Yang Lin and Yi-Liang Liu, research scientists Rong Cao and Yonghui Zhang, and postdoctoral associate Ke Wang. Taiwan collaborators included Chia-I Liu, Wen-Yih Jeng, Tzu-Ping Ko and Andrew H. Wang.

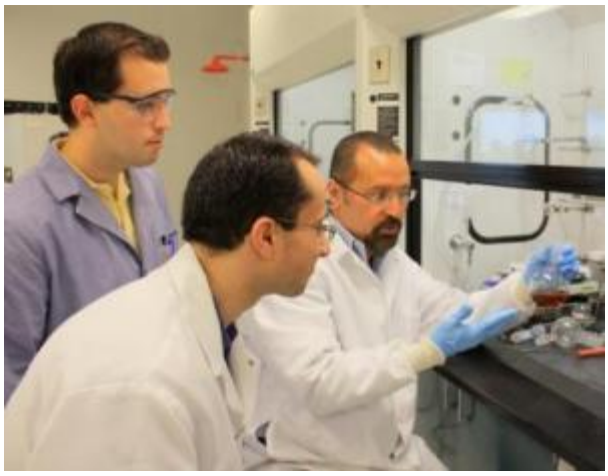
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Illinois at Urbana-Champaign**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. F.-Y. Lin, C.-I. Liu, Y.-L. Liu, Y. Zhang, K. Wang, W.-Y. Jeng, T.-P. Ko, R. Cao, A. H.- J. Wang, E. Oldfield. **Mechanism of action and inhibition of dehydrosqualene synthase**. *Proceedings of the National Academy of Sciences*, 2010; 107 (50): 21337 DOI: 10.1073/pnas.1010907107

http://www.sciencedaily.com/releases/2011/01/110118143230.htm

Special Sugar, Nanoparticles Combine to Detect Cholera Toxin



Dr. Perez works in his lab. (Credit: Courtesy of Dr. Perez.)

ScienceDaily (Jan. 18, 2011) — A complex sugar may someday become one of the most effective weapons to stop the spread of cholera, a disease that has claimed thousands of lives in Haiti since the devastating earthquake last year.

A technique developed by University of Central Florida scientists would allow relief workers to test water sources that could be contaminated with the cholera toxin. In the test, the sugar dextran is coated onto iron oxide nanoparticles and then added to a sample of the water. If the cholera toxin is present, the toxin will bind to the nanoparticles' dextran. This is because dextran looks similar to the cholera toxin receptor (GM1) found on cells' surface in the victim's gut.

The technique likely would be less expensive than those currently available, and it would provide results more quickly, enabling workers to restrict access to contaminated sources and limit the spread of the disease.

"It's really quite amazing," said UCF assistant professor J. Manuel Perez, the lead researcher on the project. "It means we have a quicker diagnostic tool using a simple and relatively cheap sugar-nanoparticle combination."

Early studies also show that the technique could someday be used to treat someone infected with cholera, which is caused by poor sanitation and dirty water, and potentially other diseases, Perez said.

More studies are needed to prove the adaptability of the technique, but its impact could be huge. In countries with poor sanitation, outbreaks caused by drinking contaminated water often prove fatal. Deadly toxins also can result from bioterrorism or food contamination.

There are an estimated 3 million to 5 million cholera cases, and 100,000 to 120,000 deaths, worldwide each year, according to the World Health Organization. A cholera outbreak has killed more than 3,000 people in Haiti since the earthquake, and WHO warned earlier in January that the outbreak has not yet reached its peak.

Research findings appear online January 18 in the journal *Bioconjugate Chemistry*. The National Institute of General Medical Sciences at the National Institutes of Health funded the research.

The findings may give the Federal Drug Administration, Centers for Disease Control and Prevention and several other agencies additional screening tools to combat toxins. The UCF-developed technique is faster than current detection methods, and it would likely be less expensive because these nanoparticles are cheap to make in large quantities. The detection instruments are compact in some cases the size of a desktop computer and a handheld calculator, and they could be turned into mobile devices that relief workers or food screeners could use in the field.

"As we have seen in the 2010 outbreak in Haiti, cholera remains a serious threat," said Janna Wehrle, Ph.D., of the National Institutes of Health, who oversees Dr. Perez's and other grants that focus on protein structures and interactions. "By developing a fast and sensitive test for cholera toxin that does not require sophisticated equipment or refrigeration, Drs. Perez and Teter have provided health care workers with a potentially valuable

tool for use in areas struck by natural disasters or with inadequate infrastructure. The possibility that the novel chemistry discovered by these investigators might also be useful for treating cholera is especially exciting."
Studies that are under way may confirm early indications that dextran can be an effective drug for patients infected with cholera, added UCF Associate Professor Kenneth Teter, a co-author on the study. This could be especially beneficial in developing countries such as Haiti, as dextran is a relatively inexpensive compound to produce.
Additionally, both dextran and iron oxide are commonly used in other medical applications. Dextran is often used to prevent blood clots anticoagulant and in emergency treatments of hemorrhagic and traumatic shock. Iron oxide nanoparticles are used to treat anemia and as MRI contrast agents to achieve improved anatomical imaging.
Other contributors on the research team include postdoctoral fellows Charalambos Kaittanis and Santimukul Santra of UCF's NanoScience Technology Center, graduate student Oscar Santiesteban of the Chemistry Department and postdoctoral fellow Tuhina Banerjee from the Burnett School of Biomedical Sciences.

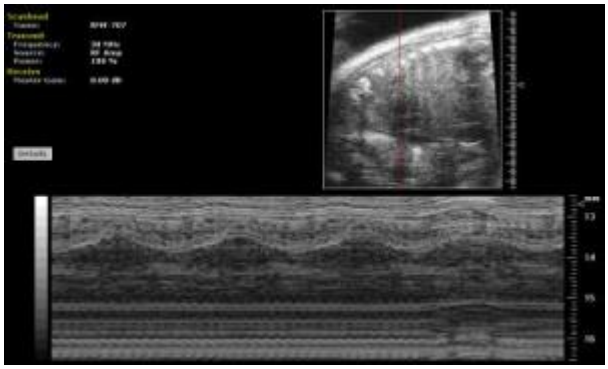
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Central Florida**.

Journal Reference:

1. Charalambos Kaittanis, Tuhina Banerjee, Santimukul Santra, Oscar J. Santiesteban, Ken Teter, J. Manuel Perez. **Identification of Molecular-Mimicry-Based Ligands for Cholera Diagnostics using Magnetic Relaxation**. *Bioconjugate Chemistry*, 2011; : 110112104343037 DOI: 10.1021/bc100442q

http://www.sciencedaily.com/releases/2011/01/110118143226.htm

Mother's Stem Cells Likely Key to Treating Genetic Disease Before Birth



This ultrasound image shows a fetal mouse heart accompanied by an M-mode Doppler reading of the heart rate. (Credit: UCSF)

ScienceDaily (Jan. 18, 2011) — UCSF researchers have tackled a decade-long scientific conundrum, and their discovery is expected to lead to significant advances in using stem cells to treat genetic diseases before birth.

Through a series of mouse model experiments, the research team determined that a mother's immune response prevents a fetus from accepting transplanted blood stem cells, and yet this response can be overcome simply by transplanting cells harvested from the mother herself.

"This research is really exciting because it offers us a straightforward, elegant solution that makes fetal stem cell transplantation a reachable goal," said senior author Tippi MacKenzie, MD, an assistant professor of pediatric surgery at UCSF and fetal surgeon at UCSF Benioff Children's Hospital. "We now, for the first time, have a viable strategy for treating congenital stem cell disorders before birth."

Scientists have long viewed in utero blood stem cell transplantation as a promising treatment strategy for many genetic diseases diagnosed as early as the first trimester of pregnancy, including sickle cell disease and certain immune disorders. Fetal stem cell transplantation involves taking healthy cells from the bone marrow of a donor and transplanting them into the fetus through ultrasound-guided injections. When successful, the implanted cells, or graft, replenish the patient's supply of healthy blood-forming cells.

In theory, the developing fetus with an immature immune system should be a prime target for successful transplantation, since the risk of graft rejection is low and the need for long-term immunosuppressive therapy may be avoided. However, most previous attempts to transplant blood stem cells into a human fetus have been unsuccessful, prompting some researchers to lose interest in this promising field, according to MacKenzie, who also is an investigator with the Eli and Edythe Broad Center of Regeneration Medicine and Stem Cell Research.

Findings from the study will appear online Jan. 18, 2011, in the *Journal of Clinical Investigation.* They also will be published in the journal's February 2011 issue.

"The fact that fetal stem cell transplantation has not been very successful has been puzzling, especially given the widely accepted dogma that the immature fetal immune system can adapt to tolerate foreign substances," said co-senior author Qizhi Tang, PhD, an assistant professor of transplant surgery and director of the UCSF Transplantation Research Lab. "The surprising finding in our study is that the mother's immune system is to blame."

In the study's first phase, researchers examined the cellular content of fetal mouse blood and found a large proportion of maternal blood cells in the fetus. Their analyses indicated that up to 10 percent of the fetus' blood cells came from the mother -- a significantly larger percentage of maternal cells than what is found anywhere else in the fetus.

"We had previously known that a minute amount of cells travel from the mother into a developing fetus and that this is an important tolerance mechanism in all healthy pregnancies," MacKenzie said. "However, the unexpectedly large proportion of maternal blood cells in the fetus made us think that perhaps it was the maternal, rather than the fetal, immune response that poses the real barrier to effective stem cell transplantation."

To further investigate this hypothesis, the team transplanted fetal mice with blood stem cells from a second strain of mice that were not matched to the fetus or the mother. Following transplantation, the researchers observed an influx of T cells -- the major driving force behind an immune response -- from the mother into the fetus, which subsequently led to rejection of the transplanted graft.

However, if the researchers removed T cells only from the mother before carrying out the transplant, nearly 100 percent of the injected fetuses engrafted, or accepted the transplanted cells, indicating that maternal T cells play the critical role in triggering transplant rejection. Finally, the researchers transplanted fetal mice with blood stem cells matched to the mother, which, as expected, resulted in a very high success rate.

"As long as the transplanted stem cells are matched to the mother, it does not seem to matter if they are matched to the fetus," said first author Amar Nijagal, MD, a postdoctoral research fellow and surgery resident at UCSF. "Transplanting stem cells harvested from the mother makes sense because the mother and her developing fetus are prewired to tolerate each other."

As next steps, researchers will need to confirm that the findings are consistent in humans and also will investigate how exactly maternal T cells cause a graft rejection.

"Now that we know a fetus can become tolerant to a foreign stem cell source, we can really think big and consider looking at how other types of stem cells might be used to treat everything from neurological disorders to muscular disorders before birth," MacKenzie added.

Additional authors include Marta Wegorzewska, Erin Jarvis, and Tom Le, all with the Eli and Edythe Broad Center of Regeneration Medicine and the UCSF Department of Surgery.

The study was funded through support from the Irene Perstein Award, UCSF Sandler Funds, the American Pediatric Surgical Association, the National Institutes of Health, the California Institute for Regenerative Medicine, the National Science Foundation, and the Joslin Diabetes and Endocrinology Research Center.

Story Source:

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

Journal Reference:

1. amar Nijagal, Marta Wegorzewska, Erin Jarvis, Tom Le, Qizhi Tang, Tippi C. Mackenzie. **Maternal T cells limit engraftment after in utero hematopoietic cell transplantation in mice**. *Journal of Clinical Investigation*, 2011; DOI: 10.1172/JCI44907

http://www.sciencedaily.com/releases/2011/01/110118122737.htm

Why First Impressions Are So Persistent

New research suggests that new experiences that contradict a first impression become 'bound' to the context in which they were made. As a result, the new experiences influence people's reactions only in that particular context, whereas first impressions still dominate in other contexts. (Credit: iStockphoto/Jacob Wackerhausen)

ScienceDaily (Jan. 18, 2011) — New research by a team of psychologists from Canada, Belgium, and the United States shows there is more than a literal truth to the saying that 'you never get a second chance to make a first impression'. The findings suggest that new experiences that contradict a first impression become 'bound' to the context in which they were made. As a result, the new experiences influence people's reactions only in that particular context, whereas first impressions still dominate in other contexts.

"Imagine you have a new colleague at work and your impression of that person is not very favourable" explains lead author Bertram Gawronski, Canada Research Chair at The University of Western Ontario. "A few weeks later, you meet your colleague at a party and you realize he is actually a very nice guy. Although you know your first impression was wrong, your gut response to your new colleague will be influenced by your new experience only in contexts that are similar to the party. However, your first impression will still dominate in all other contexts."

According to Gawronski, our brain stores expectancy-violating experiences as exceptions-to-the-rule, such that the rule is treated as valid except for the specific context in which it has been violated.

To investigate the persistence of first impressions, Gawronski and his collaborators showed their study participants either positive or negative information about an unknown individual on a computer screen. Later in the study, participants were presented with new information about the same individual, which was inconsistent with the initial information. To study the influence of contexts, the researchers subtly changed the background color of the computer screen while participants formed an impression of the target person.

When the researchers subsequently measured participants' spontaneous reactions to an image of the target person, they found the new information influenced participants' reactions only when the person was presented against the background in which the new information had been learned. Otherwise, participants' reactions were still dominated by the first information when the target person was presented against other backgrounds.

Although these results support the common observation that first impressions are notoriously persistent, Gawronski notes they can sometimes be changed. "What is necessary is for the first impression to be challenged in multiple different contexts. In that case, new experiences become decontextualized and the first

impression will slowly lose its power. But, as long as a first impression is challenged only within the same context, you can do whatever you want. The first impression will dominate regardless of how often it is contradicted by new experiences."
According to Gawronski, the research also has important implications for the treatment of clinical disorders. "If someone with phobic reactions to spiders is seeking help from a psychologist, the therapy will be much more successful if it occurs in multiple different contexts rather than just in the psychologist's office."
The research, co-authored with Robert Rydell, Bram Vervliet, and Jan De Houwer, is published in the latest issue of the *Journal of Experimental Psychology: General*.

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

Journal Reference:

1. Bertram Gawronski, Robert J. Rydell, Bram Vervliet, Jan De Houwer. **Generalization versus contextualization in automatic evaluation.**. *Journal of Experimental Psychology: General*, 2010; 139 (4): 683 DOI: 10.1037/a0020315

http://www.sciencedaily.com/releases/2011/01/110118113445.htm

ESA's Mercury Mapper Feels the Heat

BepiColombo's Mercury Magnetospheric Orbiter (MMO) in the Large Space Simulator at ESTEC, The Netherlands. The octagonal spacecraft is Japan's contribution to BepiColombo and will explore Mercury's magnetic field. (Credit: ESA/JAXA)

ScienceDaily (Jan. 18, 2011) — Key components of the ESA-led Mercury mapper BepiColombo have been tested in a specially upgraded European space simulator. ESA's Large Space Simulator is now the most powerful in the world and the only facility capable of reproducing Mercury's hellish environment for a full-scale spacecraft.

The Mercury Magnetospheric Orbiter (MMO) has survived a simulated voyage to the innermost planet. The octagonal spacecraft, which is Japan's contribution to BepiColombo, and its ESA sunshield withstood temperatures higher than 350°C.

This is a taste of things to come for the spacecraft. BepiColombo will encounter fully ten times the radiation power received by a satellite in orbit around Earth and, to simulate this, the Large Space Simulator (LSS) at ESA's ESTEC centre in the Netherlands had to be specially adapted.

Engineers talk about the power of the Sun in units called the solar constant. This is how much energy is received every second through a square metre of space at the distance of Earth's orbit.

"Previously, the LSS was capable of simulating a solar constant or two. Now it has been upgraded to produce ten solar constants," says Jan van Casteren, ESA BepiColombo project manager.

The improvements have been achieved in two ways: the lamps from the simulators are being used at their maximum power and the mirrors that focus the beam have been adjusted.`

Instead of producing a parallel beam of light 6 m across, they now concentrate the light into a cone just 2.7 m in diameter when it reaches the spacecraft. This creates a beam so fierce that a new shroud with a larger cooling capacity had to be installed to 'catch' the light that missed the spacecraft and prevent the chamber walls from heating up.

BepiColombo consists of separate modules. The MMO will investigate the magnetic environment of Mercury. It is kept cool during its six-year cruise to Mercury by the sunshield. These are the two modules that have now completed their thermal tests.

"The sunshield test was successful. Its function to protect the MMO spacecraft during the cruise phase was demonstrated," says Jan.

Once at Mercury, most of the Sun's fearsome heat will be prevented from entering BepiColombo by special thermal blankets. They consist of multiple layers including a white ceramic outer layer and several metallic layers to reflect as much heat as possible back into space.
"The tests allowed us to measure the thermal blanket's performance. The results allow us to prepare some adjustments for the tests of the Mercury Planetary Orbiter next year," says Jan.
In addition to enduring temperatures of 350°C, ESA's Mercury Planetary Orbiter (MPO) will go where no spacecraft has gone before: down into a low elliptical orbit around Mercury, of between just 400 km and 1500 km above the planet's scorching surface.
At that proximity, Mercury is worse than a hot plate on a cooker, releasing floods of infrared radiation into space. So, the MPO will have to deal with this as well as the solar heat. The MPO begins its tests in the LSS in the summer.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **European Space Agency**.

http://www.sciencedaily.com/releases/2011/01/110118101231.htm

Are Sharks Color Blind?

New research suggests that although the eyes of sharks function over a wide range of light levels, they only have a single long-wavelength-sensitive cone type in the retina and therefore are potentially totally color blind. (Credit: iStockphoto/Ian Scott)

ScienceDaily (Jan. 18, 2011) — Sharks are unable to distinguish colors, even though their close relatives rays and chimaeras have some color vision, according to new research by Dr. Nathan Scott Hart and colleagues from the University of Western Australia and the University of Queensland in Australia.

Their study shows that although the eyes of sharks function over a wide range of light levels, they only have a single long-wavelength-sensitive cone* type in the retina and therefore are potentially totally color blind. Hart and team's findings are published online in Springer's journal *Naturwissenschaften*.

"This new research on how sharks see may help to prevent attacks on humans and assist in the development of fishing gear that may reduce shark bycatch in long-line fisheries. Our study shows that contrast against the background, rather than colour per se, may be more important for object detection by sharks. This may help us to design long-line fishing lures that are less attractive to sharks as well as to design swimming attire and surf craft that have a lower visual contrast to sharks and, therefore, are less 'attractive' to them," said Prof. Hart.

Sharks are efficient predators and their evolutionary success is thought to be due in part to an impressive range of sensory systems, including vision. To date, it is unclear whether sharks have color vision, despite well-developed eyes and a large sensory brain area dedicated to the processing of visual information. In an attempt to demonstrate whether or not sharks have color vision, Hart and colleagues used a different technique -- microspectrophotometry -- to identify cone visual pigments in shark retinas and measure their spectral absorbance.

They looked at the retinas of 17 shark species caught in a variety of waters in both Queensland and Western Australia. Rod cells were the most common type of photoreceptor in all species. In ten of the 17 species, no cone cells were observed. However, cones were found in the retinae of 7 species of shark from three different families and in each case only a single type of long-wavelength-sensitive cone photoreceptor was present. Hart and team's results provide strong evidence that sharks possess only a single cone type, suggesting that sharks may be cone monochromats, and therefore potentially totally color blind.

The authors conclude: "While cone monochromacy on land is rare, it may be a common strategy in the marine environment. Many aquatic mammals − whales, dolphins and seals − also possess only a single, green-

sensitive cone type. It appears that both sharks and marine mammals may have arrived at the same visual design by convergent evolution, in other words, they acquired the same biological trait in unrelated lineages."
***Note**: There are two main types of photoreceptor cells in the retina of the eye. Rod cells are very sensitive to light and allow night vision. Cone cells also react to light but are less sensitive to it. Eyes with different spectral types of cone cells can distinguish different colors. Rod cells cannot tell colors apart.
***E*Story Source:**
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Springer Science+Business Media**, via AlphaGalileo.

Journal Reference:

1. Nathan Scott Hart, Susan Michelle Theiss, Blake Kristin Harahush, Shaun Patrick Collin. **Microspectrophotometric evidence for cone monochromacy in sharks**. *Naturwissenschaften*, 2011; DOI: 10.1007/s00114-010-0758-8

http://www.sciencedaily.com/releases/2011/01/110118092224.htm

Nanotech Medicine to Rebuild Damaged Parts of a Human Body?

Nanotechnology helps to restore burnt tissue. (Credit: Image courtesy of Eureka)

ScienceDaily (Jan. 18, 2011) — To rebuild damaged parts of a human body from scratch is a dream that has long fired human imagination, from Mary Shelley's Doctor Frankenstein to modern day surgeons. Now, a team of European scientists, working in the frame of the EUREKA project ModPolEUV, has made a promising contribution to reconstructive surgery thanks to an original multidisciplinary approach matching cutting-edge medicine to the latest developments in nanotechnology.

According to the World Health Organisation (WHO), an estimated 322,000 deaths globally per year are linked to severe injuries from fire and in many of these cases death could have been avoided with surgical intervention.

In this type of intervention, when major burn patients have insufficient skin left to graft on the most damaged part of their body, new skin has literally to be grown from the patient's own skin cells. However, the long delay in growing the skin can expose the burns patient to increased risk of infection and dehydration; so to help those cells to multiply, specialists use a particular kind of component called polymeric material. Because of their extraordinary range of properties, polymeric materials play a ubiquitous role in our daily life. This role ranges from familiar synthetic plastics: plastic bags or yoghurt cups, to natural biopolymers such as wood or proteins that are present in the human body.

New nano-structured materials

It has been known for the last few years that man made synthetic polymeric materials have the potential to grow and multiply human cells. 'About 10 years ago, scientists discovered the important influence that nano-structures had on the way a line of cells would develop. It was the beginning of an entire new scientific field, somewhere between medicine and nanotechnology,' says Professor Johannes Heitz, Senior Research Associate at the University of Linz, Austria and main coordinator of the ModPolEUV project.

In the case of human skin cells, re-implantation of the tissue can be performed once a sufficient amount of skin is obtained, by growing it on a polymeric material surface.

However, in many cases, imperfections in the material structure can make the process relatively long and sometimes inefficient, with cells developing erratically.

The team of Austrian, Czech and Polish scientists involved in the research project managed to develop a new and simple way to create nano-structured materials that would allow a better development of human cells.

The Polish partner in the team, the Military University of Technology of Warsaw, has been in charge of the development of the new laser-based technology called EUV (Extreme Ultra-Violet) that was used for the creation of the nano-structured polymer surfaces. A beam of EUV light formed with a unique mirror

developed by the Czech partner REFLEX S.R.O is directed on the surface allowing the creation of new kinds of polymeric materials. This innovative technique allows for a very high degree of precision, from 10 to 20 nanometres, whereas conventional techniques allowed only for a maximal precision level of 100 nanometres. 'One of the newest theories in the field of cell growing is that the smaller the structure, the wider the possibilities to manipulate cells,' says Professor Heitz.

A wide range of human cells

The EUV technique, thanks to its particular level of precision, also allows for the conservation of the material's structure, which was not the case with other methods used to modify the polymer. 'A regular structure is essential if the material is to be used for the purpose of growing human cells,' says Dr Henryk Fiederowicz, Professor at the Military University of Technology.

The story does not end there. Nano-structures built through the EUV technique have the ability to influence the behaviour of organic cells and different kind of cells can be grown better and faster depending on the type of polymer surface used.

The variety of material used to grow human stem cells will determinate the way cells will differentiate, meaning that they will transform into another human cell type. In other words: 'Using one type of polymer material or another will help you grow different types of muscle, nerves, cells adapted to a human heart, bone or any other part of the human body,' says Professor Heitz.

Thanks to their affinity to human tissue and cells, polymeric materials could also be used for designing entire artificial implants. Indeed, many types of implants are already being made out of polymer materials, such as heart valves and bloods vessels. Using the EUV technique would reduce the odds of implant rejection, as the range of new materials created could be adapted to interact perfectly with specific parts of a patient's body.

Broad applications

All partners agree on the fact that EUREKA has helped them to find elsewhere in Europe the expertise and skills unavailable in their own countries. The next step is to bring their innovation to the market.

The Military Institute of Technology has already handled several EUV installations to laboratories in the USA, Germany, the Czech Republic, France, Japan, China and South Korea. It is now preparing for a full commercial phase, in partnership with the Polish company PREVAC, a leader in the market of high-precision instruments.

Applications of this novel technique could go far beyond nano-medicine and bio-technologies. An important potential market could be the one of micro-electronics, with its ever-expanding need for high-precision lithography; applications could be proposed to every type of industry where nano-structures are used. For instance, in micro-mechanics, integrated optics, wear reduction or the production of nano-composite materials.

For researchers at Linz University, the cell-growing technology is still in a testing phase and Professor Heitz prefers not to be overwhelmed by enthusiasm, even though he concedes that results have been 'very encouraging so far'. 'The interaction of cells with which structure dimensions are below 100 nanometres is currently the topic of a huge international effort,' he says. Despite the importance of the innovation 'our contribution is very small when compared to the many other laboratories working in this field at the moment'. According to Professor Heitz, 'recreating whole organs is still a scientist's dream'. Yet the outcome of the E! 3892 ModPolEUV project might just have brought the dream a little closer to reality.

Story Source:

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

http://www.sciencedaily.com/releases/2011/01/110118092140.htm

Indoor Air Pollution: Minerals Reduce Impact of Formaldehyde in Particle Board on Indoor Air Quality

Minerals provide better indoor air. (Credit: Image courtesy of Fraunhofer-Gesellschaft)

ScienceDaily (Jan. 17, 2011) — One of the sources of emission for pollutants in living spaces are particleboards glued with adhesives that contain formaldehyde. There is a new method that will now provide another way to reduce these vapors. The trick can be found in special minerals that equip wood materials with properties for cleaning air in living spaces.

Since the 50s, formaldehyde has been the basic material for many artificial resins and glues used in particleboards and plywood boards. Estimates indicate that more than 85 percent of all wood materials have adhesives containing formaldehyde. This substance escapes from the materials and, along with other sources, pollutes indoor air. This is why numerous ways have been developed to reduce emissions, and the International Agency for Research on Cancer (IARC) of the World Health Organization WHO has even classified formaldehyde as carcinogenic for humans. Thereupon both the existing threshold value of 0.1 ppm issued by Germany's then-Federal Health Office in 1977 and WHO's standard value of 100 micrograms per cubic meter ($\mu g/m^3$) have been confirmed.

Researchers at the Fraunhofer Institute for Wood Research, Wilhelm-Klauditz-Institut WKI in Braunschweig, Germany, and the Fraunhofer Institute for Silicate Research ISC in Würzburg, Germany, have found a new method to reduce formaldehyde emissions from particleboard: modified zeolites. These are aluminosilicates that function as a molecular sieve due to their extremely large inner surface and porous structure so that they can absorb formaldehyde particularly well. Dr. Katrin Bokelmann ought to know because she is the project manager at the Fraunhofer Institute for Silicate Research who, along with her team, is in charge of manufacturing mineral compounds. As she puts it: "Zeolites are already used as a filling material in particleboards, but it's an entirely new idea to use them for adsorbing pollutants in wood materials."

The researchers were not able to achieve sufficiently high rates of adsorption in their tests of various commercially available or natural minerals. The best adsorption properties of these aluminosilicates were measured in synthetic zeolite Y, which the experts modified and improved with amino groups. Dr. Jan Gunschera is the project manager at the Fraunhofer Institute for Wood Research and this is how he sees it:

"We noticed a 70 percent boost in the adsorption rate after we added formaldehyde to the processed material in our measuring chambers and then we put five percent by weight of the zeolite powder directly into our sample particleboards made of spruce roundwood. The result was that formaldehyde emissions from the board dropped 40 percent -- both short-term and long-term tests of one month confirm these findings. In other words, the air in living spaces should be measurably improved. Our tests indicate that this technology can even reduce indoor air pollutant levels." The properties of the wood materials did not undergo any negative influence from the zeolites, it was reported.
The researchers have applied for a patent for the new technique and think that modified zeolites -- worked into furniture or ceiling panels -- could conceivably reduce not only formaldehyde but also other aldehyde levels in indoor air. Scientists are currently looking for partners from the wood materials industry to mass-produce particleboards.
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Fraunhofer-Gesellschaft**.

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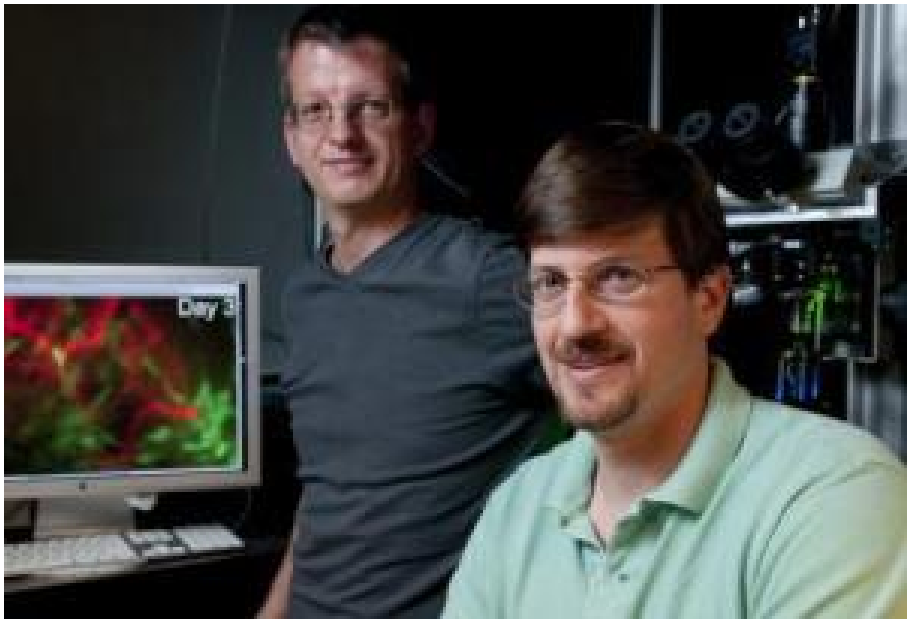
http://www.sciencedaily.com/releases/2011/01/110110090432.htm

New Technique to See Neurons of the Deep Brain for Months at a Time



Mark Schnitzer, associate professor of biology and applied physics, right, and Juergen Jung, operations director of the Schnitzer lab, in front of the microscope setup used to image the deep brain. (Credit: L.A. Cicero, Stanford University News Service)

ScienceDaily (Jan. 17, 2011) — Travel just one millimeter inside the brain and you'll be stepping into the dark. Standard light microscopes don't allow researchers to look into the interior of the living brain, where memories are formed and diseases such as dementia and cancer can take their toll.

But Stanford scientists have devised a new method that not only lets them peer deep inside the brain to examine its neurons but also allows them to continue monitoring for months.

The technique promises to improve understanding of both the normal biology and diseased states of this hidden tissue.

Other recent advances in micro-optics had enabled scientists to take a peek at cells of the deep brain, but their observations captured only a momentary snapshot of the microscopic changes that occur over months and years with aging and illness.

The Stanford development appears online Jan. 16 in the journal *Nature Medicine*. It also will appear in the February 2011 print edition.

Scientists study many diseases of the deep brain using mouse models, mice that have been bred or genetically engineered to have diseases similar to human afflictions.

"Researchers will now be able to study mouse models in these deep areas in a way that wasn't available before," said senior author Mark Schnitzer, associate professor of biology and of applied physics.

Because light microscopy can only penetrate the outermost layer of tissues, any region of the brain deeper than 700 microns or so (about 1/32 of an inch) cannot be reached by traditional microscopy techniques.

Recent advances in micro-optics had allowed scientists to briefly peer deeper into living tissues, but it was nearly impossible to return to the same location of the brain and it was very likely that the tissue of interest would become damaged or infected.

With the new method, "Imaging is possible over a very long time without damaging the region of interest," said Juergen Jung, operations manager of the Schnitzer lab. Tiny glass tubes, about half the width of a grain of rice, are carefully placed in the deep brain of an anaesthetized mouse. Once the tubes are in place, the brain is not exposed to the outside environment, thus preventing infection. When researchers want to examine the cells and their interactions at this site, they insert a tiny optical instrument called a microendoscope inside the

glass guide tube. The guide tubes have glass windows at the ends through which scientists can examine the interior of the brain.
"It's a bit like looking through a porthole in a submarine," said Schnitzer.
The guide tubes allow researchers to return to exactly the same location of the deep brain repeatedly over weeks or months. While techniques like MRI scans could examine the deep brain, "they couldn't look at individual cells on a microscopic scale," said Schnitzer. Now, the delicate branches of neurons can be monitored during prolonged experiments.
To test the use of the technique for investigating brain disease, the researchers looked at a mouse model of glioma, a deadly form of brain cancer. They saw hallmarks of glioma growth in the deep brain that were previously known in tumors described as surficial (on or near the surface).
The severity of glioma tumors depends on their location. "The most aggressive brain tumors arise deep and not superficially," said Lawrence Recht, professor of neurology and neurological sciences. Why the position of glioma tumors affects their growth rate isn't understood, but this method would be a way to explore that question, Recht said.
In addition to continuing their studies of brain disease and the neuroscience of memory, the researchers hope to teach other researchers how to perform the technique.
The first three authors of the paper (all of whom contributed equally to the study) are Robert Barretto, a former doctoral student in biophysics and now a postdoctoral researcher at Columbia University Medical Center; Tony Ko, a former postdoctoral researcher in the Department of Biology; and Jung. Also contributing to the work -- and listed as authors -- are Tammy Wang, a former undergraduate in biomedical engineering; George Capps and Allison Waters, both former undergraduates in biology; and Yaniv Ziv and Alessio Attardo, both postdoctoral researchers in biology.

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

Journal Reference:

1. Robert P J Barretto, Tony H Ko, Juergen C Jung, Tammy J Wang, George Capps, Allison C Waters, Yaniv Ziv, Alessio Attardo, Lawrence Recht, Mark J Schnitzer. **Time-lapse imaging of disease progression in deep brain areas using fluorescence microendoscopy**. *Nature Medicine*, 2011; DOI: 10.1038/nm.2292

http://www.sciencedaily.com/releases/2011/01/110116144446.htm

Smoking Causes Genetic Damage Within Minutes After Inhaling

Cigarette smoke begins to cause genetic damage within minutes -- not years -- after inhalation into the lungs, new research shows. (Credit: iStockphoto/Markus Divis)

ScienceDaily (Jan. 17, 2011) — In research described as "a stark warning" to those tempted to start smoking, scientists are reporting that cigarette smoke begins to cause genetic damage within minutes -- not years -- after inhalation into the lungs.

Their report, the first human study to detail the way certain substances in tobacco cause DNA damage linked to cancer, appears in *Chemical Research in Toxicology*, one of 38 peer-reviewed scientific journals published by the American Chemical Society.

Stephen S. Hecht, Ph.D., and colleagues point out in the report that lung cancer claims a global toll of 3,000 lives each day, largely as a result of cigarette smoking. Smoking also is linked to at least 18 other types of cancer. Evidence indicates that harmful substances in tobacco smoke termed polycyclic aromatic hydrocarbons, or PAHs, are one of the culprits in causing lung cancer. Until now, however, scientists had not detailed the specific way in which the PAHs in cigarette smoke cause DNA damage in humans.

The scientists added a labeled PAH, phenanthrene, to cigarettes and tracked its fate in 12 volunteers who smoked the cigarettes. They found that phenanthrene quickly forms a toxic substance in the blood known to trash DNA, causing mutations that can cause cancer. The smokers developed maximum levels of the substance in a time frame that surprised even the researchers: Just 15-30 minutes after the volunteers finished smoking. Researchers said the effect is so fast that it's equivalent to injecting the substance directly into the bloodstream.

"This study is unique," writes Hecht, an internationally recognized expert on cancer-causing substances found in cigarette smoke and smokeless tobacco. "It is the first to investigate human metabolism of a PAH specifically delivered by inhalation in cigarette smoke, without interference by other sources of exposure such as air pollution or the diet. The results reported here should serve as a stark warning to those who are considering starting to smoke cigarettes," the article notes.

The authors acknowledged funding from the National Cancer Institute.

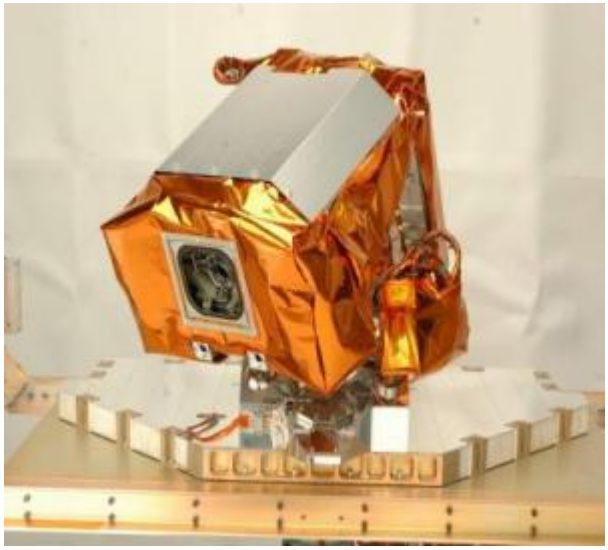
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **American Chemical Society**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Yan Zhong, Steven G. Carmella, Pramod Upadhyaya, J. Bradley Hochalter, Diane Rauch, Andrew Oliver, Joni Jensen, Dorothy Hatsukami, Jing Wang, Cheryl Zimmerman, Stephen S. Hecht. **Immediate Consequences of Cigarette Smoking: Rapid Formation of Polycyclic Aromatic Hydrocarbon Diol Epoxides**. *Chemical Research in Toxicology*, 2010; 101227010050010 DOI: 10.1021/tx100345x

http://www.sciencedaily.com/releases/2011/01/110116144452.htm

Improved Measurements of Sun to Advance Understanding of Climate Change



Better satellite instruments are improving measurements of solar energy reaching Earth, scientists report in Geophysical Research Letters. Exactly determining the contribution of solar fluctuations to rising global temperature is expected to become possible as new instruments, such as the Total Irradiance Monitor above, further refine solar measurements. The device is scheduled to launch next month on NASA's Glory spacecraft. (Credit: NASA)

ScienceDaily (Jan. 17, 2011) — Scientists have taken a major step toward accurately determining the amount of energy that the sun provides to Earth, and how variations in that energy may contribute to climate change. In a new study of laboratory and satellite data, researchers report a lower value of that energy, known as total solar irradiance, than previously measured and demonstrate that the satellite instrument that made the measurement -- which has a new optical design and was calibrated in a new way -- has significantly improved the accuracy and consistency of such measurements.

The new findings give confidence, the researchers say, that other, newer satellites expected to launch starting early this year will measure total solar irradiance with adequate repeatability -- and with little enough uncertainty -- to help resolve the long-standing question of how significant a contributor solar fluctuations are to the rising average global temperature of the planet.

"Improved accuracies and stabilities in the long-term total solar irradiance record mean improved estimates of the sun's influence on Earth's climate," said Greg Kopp of the Laboratory for Atmospheric and Space Physics (LASP) of the University of Colorado Boulder.

Kopp, who led the study, and Judith Lean of the Naval Research Laboratory, in Washington, D.C., published their findings January 14 in *Geophysical Research Letters*, a journal of the American Geophysical Union.

The new work will help advance scientists' ability to understand the contribution of natural versus anthropogenic causes of climate change, the scientists said. That's because the research improves the accuracy of the continuous, 32-year record of total solar irradiance, or TSI. Energy from the sun is the primary energy input driving Earth's climate, which scientific consensus indicates has been warming since the Industrial Revolution.

Lean specializes in the effects of the sun on climate and space weather. She said, "Scientists estimating Earth's climate sensitivities need accurate and stable solar irradiance records to know exactly how much warming to attribute to changes in the sun's output, versus anthropogenic or other natural forcings."

The new, lower TSI value was measured by the LASP-built Total Irradiance Monitor (TIM) instrument on the NASA Solar Radiation and Climate Experiment (SORCE) spacecraft. Tests at a new calibration facility at LASP verify the lower TSI value. The ground-based calibration facility enables scientists to validate their instruments under on-orbit conditions against a reference standard calibrated by the National Institute of Standards and Technology (NIST). Before the development of the calibration facility, solar irradiance instruments would frequently return different measurements from each other, depending on their calibration.

To maintain a long-term record of the sun's output through time, scientists had to rely on overlapping measurements that allowed them to intercalibrate among instruments.
Kopp said, "The calibration facility indicates that the TIM is producing the most accurate total solar irradiance results to date, providing a baseline value that allows us to make the entire 32-year record more accurate. This baseline value will also help ensure that we can maintain this important climate data record for years into the future, reducing the risks from a potential gap in spacecraft measurements."
Lean said, "We are eager to see how this lower irradiance value affects global climate models, which use various parameters to reproduce current climate: incoming solar radiation is a decisive factor. An improved and extended solar data record will make it easier for us to understand how fluctuations in the sun's energy output over time affect temperatures, and how Earth's climate responds to radiative forcing."
Lean's model, which is now adjusted to the new lower absolute TSI values, reproduces with high fidelity the TSI variations that TIM observes and indicates that solar irradiance levels during the recent prolonged solar minimum period were likely comparable to levels in past solar minima. Using this model, Lean estimates that solar variability produces about 0.1o Celsius (0.18o Fahrenheit) global warming during the 11-year solar cycle, but is likely not the main cause of global warming in the past three decades.
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Colorado at Boulder**.

Journal Reference:

1. Greg Kopp, Judith L. Lean. **A new, lower value of total solar irradiance: Evidence and climate significance**. *Geophysical Research Letters*, 2011; 38 (1) DOI: 10.1029/2010GL045777

http://www.sciencedaily.com/releases/2011/01/110114155342.htm

Rx for Catastrophe

A book on disaster law and policy urges stronger federal intervention to shore up natural barriers and protect the most vulnerable members of the community.

By Melinda Burns

A photograph of a bayou in Louisiana. One law professor looks at disaster law and policy in the wake of Hurricane Katrina, and urges stronger federal intervention to shore up natural barriers as well as protecting the most vulnerable members of the community. (Google Images)

Three days after Hurricane Katrina plowed into New Orleans, swamping 80 percent of the city, a group of 200 evacuees, most of them African-American, fled the wretched conditions of the Superdome and Convention Center and set out to find food and shelter in Gretna, a nearby white working-class suburb.

When the evacuees arrived at the Crescent City Connection, a highway bridge that offered one of the few escape routes out of the flood, they were greeted by a line of white Gretna police officers who fired their shotguns into the air. Gretna, the police told the crowd, was "closed."

This dramatic standoff, now the subject of a tangle of lawsuits, was not an anomaly: It had happened before, says Robert R.M. Verchick, the author of *Facing Catastrophe: Environmental Action for a Post-Katrina World*, a compelling recent book on disaster law and policy.

During the Great Mississippi Flood of 1927, steamboat captains refused to take black sharecroppers to safety, even as black men were hunted down through floodwaters and conscripted into levee gangs. After the San Francisco earthquake of 1906, white residents stoned Japanese Americans, looted Chinatown and barred re-entry to the Chinese who had fled the wreckage. And in the aftermath of the Loma Prieta earthquake of 1989 in California, the residents of Watsonville, a city with a great number of Latino farm workers, were left homeless the longest.

"Perhaps what is surprising about Gretna is that such callousness could take place in 21st-century America," Verchick says. "But if disasters teach us anything, it is that a people should never consider itself immune."

Read the book

Facing Catastrophe: Environmental Action for a Post-Katrina World
By Robert R. M. Verchick
Harvard University Press, $45

A Katrina survivor himself, Verchick is on leave from his job as a professor of environmental law at Loyola University in New Orleans to serve in the Obama administration. His book makes a powerful case for reshaping federal laws and policies in order to better protect wetlands, forests and rivers — what Verchick calls "green infrastructure" — and to ensure that the poor and all those living "on the wrong side of the ecological tracks" receive special attention when disaster strikes.

Three simple maxims for disaster preparation and recovery — "Go Green; Be Fair; and Keep Safe" — should be a guide for government, Verchick says. His book was written before last year's earthquake in Haiti, oil spill in the Gulf of Mexico and floods in Pakistan, but Verchick frames the lessons of Katrina as universal.

The term "natural" as applied to disasters is a misnomer, he says. Some of the damage can almost always be traced back to failures of engineering, bad land-use planning or a chaotic emergency response. And despite what the media says, earthquakes and floods are not "social equalizers" that affect the rich and poor alike.

"Catastrophe is bad for everyone, but it is especially bad for the weak and the disenfranchised."

As deputy associate administrator at the Washington, D.C., Office of Policy, Economics, and Innovation of the U.S. Environmental Protection Agency, Verchick is now an insider in his quest to make government more accountable. It's not charity that people need after a disaster, he says in *Facing Catastrophe*: It's justice, in terms of the social contract between a government and its citizens. There should be no disagreement about protecting the poor from cyclical storms or shoddy levees.

"For nearly 100 years, that has been as basic a duty as protecting our shores from military invasion," Verchick says. "That our leaders stripped such basic security from us — without any notice or even debate — is cause for alarm and should be a source of deep shame."

Facing Catastrophe opens with an imaginary tour through a Louisiana bayou. Verchick calls attention to the thickets of live oaks dripping with Spanish moss and the mucky brown-green water dotted with bits of leaves and thick as "a tureen of lentil soup." As he paddles along, he points out the green herons, snapping turtles and alligators.

"All of this looks like wilderness, but it's not," Verchick says. Farming, logging, fishing, oil and gas exploration and real estate development have carved up the swamps and wetlands of Louisiana into a maze of channels. The marshlands act as vast sponges that soak up tropical storms, but, starved of water and nutrients, they are eroding into the sea at the rate of 30 square miles per year. From a canoe, the bayous may seem to be thriving, but from a plane, they look like "green shag carpet being eaten by a Pac Man."

Wetlands, Verchick says, are "green infrastructure" cheaper and stronger than artificial barriers and just as worthy of investment as airports or roads. Wetlands can act as "meteorological speed bumps" that block the punch of big storms, not only at the mouth of the Mississippi but also on the deltas of the Nile, Mekong and Yangtze rivers. Half the world's population lives along a coast. But left to market forces, the coast is being continually degraded for economic gain.

"A high price leads to judicious use and perhaps conservation," Verchick says. "A low price leads to gluttony. In traditional markets, "nature is worth more dead than alive."

But there are grounds for hope. In New Orleans, Katrina has helped temper the U.S. Army Corps of Engineers' love affair with concrete. The corps, whose levees failed spectacularly to protect the city in the summer of 2005, is now committed to a strategy of multiple lines of defense for the Louisiana coast, one that would replace lost wetlands and build up barrier islands in addition to building levees. Spanning hundreds of miles, it may be the largest effort to reclaim a coast for storm protection in the world, and it will take a generation to complete.

"The good news is that public awareness of the problem is at an all-time high," Verchick says. "… For the first time, the federal government may be getting serious about restoring the coast, understanding that it will take billions, not millions of dollars."

Still, there is much more to be done. The U.S. needs a new federal agency solely devoted to flood control, Verchick says, one that emphasizes natural restoration and environmental protection and has the funding to carry out its mission. A "green tax" should be levied on the oil and gas industry to restore the coast it helped dismantle. Property owners who incur storm damage caused by man-made wetland loss should be allowed to sue the guilty parties.

Wilderness, Verchick says, is "the least protected domain in American property law."

Verchick's single-minded focus on the "services" provided by the natural environment is occasionally jarring, as if marshland had no higher value than for flood protection. But his discussion of the disproportionate suffering of the poor during disasters is eye-opening and eloquent.

Reviewing the history of New Orleans' shoddy levees and bungled emergency response to Katrina, including the manner in which hundreds of thousands of people, many of them poor African-Americans, were permanently displaced in cities throughout the nation — the largest involuntary migration in America since the Dust Bowl — Verchick shows how the heaviest burdens of a catastrophe are borne by the people with the least power.

It's a worldwide pattern. During the Kashmir earthquake of 2005 and the Latur earthquake of 1993 in India, many more women died than men because more women were at home. After Cyclone Nargis hit Myanmar in 2008, an estimated 134,000 people were believed to be dead or missing, victims in part of a dictatorship that simply didn't care. The Myanmar government had no relief plan for a major cyclone and, in the aftermath, denied access to international aid workers. The Karens, the largest minority group in the region, were reportedly left behind while ethnic Burmese were ferried to safety in the storm.

In the U.S., Verchick says, the hurricane belt of the Gulf and southern Atlantic states has a racial character because of the large number of heavily black counties and parishes along the coast. The areas damaged by Katrina in New Orleans proper were 75 percent black. Historically, African-Americans were shunted to the low-lying, flood-prone parts of town. National hurricane policy is an African-American issue, Verchick says.

"As any native Orleanian will tell you, 'Water flows away from money,'" he says.

After Katrina, the Bush administration refused emergency funds for public sector salaries, and 3,000 city employees were fired. Three historic federal public housing buildings were demolished. At the same time, lucrative contracts for rebuilding were awarded to Halliburton, Bechtel Corp., and Blackwater USA without going out for bids.

America should shore up its health and safety laws to help the poorest members of society recover from the shock of a catastrophe, Verchick says. The Superfund should be replenished to speed up toxic cleanups and prevent spills during floods. Evacuation plans should be drawn up in consultation with poor communities.

Congress should consider legislation to guide compensation funds for disaster victims. And the president, Verchick says in the book, should issue an executive order on disaster justice, one that would hold all federal agencies accountable for protecting the poor, the young, the elderly, the disabled and the undocumented against conditions that put them at special risk.

In Facing Catastrophe, Verchick describes the jazz funeral that was staged during Carnival in New Orleans in 2005 to commemorate the lives lost in Katrina, more than 1,800 in all. There was a dirge-like march from the church to the cemetery, and then, after burial, came the "second line" with its scream of trumpets, syncopated percussion and high-stepping dancers with swooping feathers.

"The idea is timeless: Death is loss and death is sad; but out of death comes hope (that 'thing with feathers,' as Emily Dickinson wrote) and the promise of a brassy resurrection," Verchick says. "This book celebrates the beginning of that second line."

http://www.miller-mccune.com/environment/rx-for-catastrophe-27565/?utm_source=Newsletter145&utm_medium=email&utm_content=0125&utm_campaign=newsletters

Slashing Solar Subsidies, and Lighting Way for China

The fine balance in Germany between markets and green energy policy highlights the real-world challenges for moving away from traditional power sources.

By Michael Scott Moore

Germany's walk-back on solar subsidies is allowing in cheaper solar infrastructure made in China. (Alex Nikada / istockphoto.com)

Germany's famous solar subsidies — which I wrote about ("Germany's Fine Failure") a year and a half ago — have come under steady pressure from Berlin since Angela Merkel's government shifted rightward in an election at the end of 2009. For the second year in a row, Germany has trimmed the public incentives that helped make this damp and overcast nation the largest solar panel market in the world.

At first it sounds like a cruel idea, particularly since Merkel and her allies have also reversed the nation's historic phase-out of nuclear power. But in fact it's a sign of health. The subsidies are working so well that Berlin wants to bring solar technology (gradually) into the mainstream energy market.

"These figures demonstrate the success of solar power in Germany and show how big interest is in renewable energy overall," Environment Minister Norbert Roettgen told journalists when he announced the subsidy cuts this month. "But in the interest of electricity consumers, the subsidies have to be made more cost efficient."

Germany's "feed-in tariffs" have made it profitable for businesses as well as individuals to install panels on their roofs or build solar parks. Solar power is still relatively expensive, but a feed-in tariff makes it worthwhile by guaranteeing an artificially high price for anyone who delivers solar energy to the national grid.

The strategy has worked. But power companies pass on those costs to consumers, which means most Germans don't bother to buy solar-generated energy. Now Germans want to ease the tariffs and make solar

power more competitive in the retail market. Berlin has cut the tariffs twice, in roughly 15 percent increments, since last year.

Overall it's a good thing — an example of governments and markets working together nicely. But lately, as Reuters reports ("Is a Solar Trade War About to Flare"), the Chinese have been taking advantage of these Western experiments with public energy policy.

Both Germany and the United States produce good photovoltaic panels, but China has built a fearsome reputation over the last decade as a provider of inexpensive equipment. "Chinese solar companies now control two-thirds of solar cell production in the $39 billion global PV market," according to Reuters, and the complaint rising from both Europe and the United States is that Beijing deliberately slashes the price of equipment so Chinese companies can take advantage of subsidies in other parts of the world.

"European and U.S. subsidies are designed to boost solar usage no matter who builds the hardware," Reuters writes. "Chinese subsidies, Western firms complain, help Chinese solar manufacturers alone."

Which has led to worries about a trade war. The United Steelworkers union in the United States has lodged a formal complaint about what it says are China's illegal subsidies, and the Obama administration may take the case to the World Trade Organization.

Of course it's fair enough for China to subsidize its own domestic industries, but solar panel manufacturers in the U.S. and Germany argue that they have almost no access to the Chinese market while China can sell equipment wherever smart subsidies are creating a solar boom.

Sen. Sherrod Brown, a Democrat from Ohio, supports the Steelworkers' complaint because his home state stands to gain or lose a lot of solar energy jobs. "Clean energy represents the future of manufacturing," he said in a statement. "Acting now means that we won't displace America's dependence on foreign oil for a dependence on Chinese-made clean energy technology."

But the Chinese argued back in a formal response to the Steelworkers' complaint that a trade war might be bad for global warming. "If the U.S. closes the door for trading with the rest of the world, including China, in renewable energy products," Beijing declared, "the U.S. may significantly delay the already long struggle for developing alternative energy sources, if not entirely destroy this opportunity for humankind."

Meanwhile, the latest trimming of solar subsidies in Germany pleased Wall Street because they were less harsh than expected. Investors saw no "dramatic harm to the industry" in the world's most important solar-power market, according to the *Wall Street Journal*, and therefore "solar power product manufacturers, particularly those based in China, saw their stocks bounce more than 10 percent."

http://www.miller-mccune.com/science-environment/slashing-solar-subsidies-and-lighting-way-for-china-27642/

Nature's Cooling Albedo Disappearing Faster Than Thought

The loss of sea ice is a concern for more than polar bears, as the loss of reflectivity it represents means the planet may warm even faster.

By Michael Todd

A view of the North Pole. Researchers say the loss of sea ice and its resulting loss of reflectivity, or albedo effect, is actually double what's previously been reported, which means the planet may warm even faster. (Wikipedia.org)

Those who reject the notion of climate change often note that there's a level of prediction in the other side's concerns, and they correlate prediction with speculation and ultimately conflate it with guessing. That's not entirely fair, but there is an element of educated guessing going on in developing models that will accurately predict tomorrow's climate. The assumption from naysayers is that when the models don't perform flawlessly, that failure can only show that global warming isn't happening.

But a new study led by the University of Michigan's Mark G. Flanner and funded in part by the National Science Foundation reminds us that models can fall short in both directions. In this case, looking at data from 1979 to 2008, the best climate models undercounted the "loss of reflectivity" from disappearing snow and sea ice — by about half.

For example, the loss of the North Pole's ice cap means dark-colored ocean water will absorb solar energy that reflective white ice and snow would otherwise reflect (something known as albedo). The researchers also noted that not all snow and ice is created equal, and variations like ponding water on ice or pollution on snow can influence albedo.

As a release quoted co-author Karen Shell, Oregon State University atmospheric scientist, "Instead of being reflected back into the atmosphere, the energy of the sun is absorbed by the Earth, which amplifies the warming. Scientists have known for some time that there is this amplification effect, but almost all of the climate models we examined underestimated the impact — and they contained a pretty broad range of scenarios."

In short, less albedo means quicker cooking. And it's not hard to see a feedback loop in which warmer temperatures mean even less ice, which means even warmer temperatures. As Shell was quoted, "The rate of energy being absorbed by the Earth through cryosphere decline — instead of being reflected back to the atmosphere — is almost 30 percent of the rate of extra energy absorption due to carbon dioxide increase between pre-industrial values and today."

Keeping tabs on sea ice has been of sufficient import that both NASA and the European Space Agency have sent up satellites specifically to keep tabs on the situation, as our Bruce Dorminey explained last year. When the ESA's first CryoSat bird crashed near the North Pole in 2005, it hot-footed a replacement that went up last summer.

The albedo researchers were careful not to attribute the loss of ice "entirely" to human activity (or even to something beyond natural variability), but increased ship traffic in the Arctic has raised some concerns. While ships already are blamed for contributing nearly 40 percent as much carbon dioxide to the atmosphere as do automobiles, ships forging a Nortwest or Northeast passage to save fuel also end up dumping smokestack soot on the ice, which accelerates melting.

As Flanner and three co-authors wrote four years ago in another paper, "Reducing Arctic [soot] concentrations sooner rather than later is the most efficient way to mitigate Arctic warming that we know of."

http://www.miller-mccune.com/environment/nature%E2%80%99s-cooling-albedo-disappearing-faster-than-thought-27599/

Empower Your Appliances with the Smart Grid

The manager of the energy portfolio for the Pacific Northwest National Laboratory discusses the benefits of evening out our day's use of electricity and how future appliances will decide when they can spark up most cheaply.

By Joan Melcher

An energy portfolio expert discusses the benefits of the smart grid to even out our day's use of electricity (Lauren Lank / stockxchange)

Despite strong financial support from the U.S. Department of Energy and increasing utility interest, smart grid remains a blurry concept among electricity consumers. That it could transform how we use energy and usher in an era where the term "peak load" — its nemesis — is relegated to similar obscurity.

The smart grid overlays advanced information technologies on the electrical grid, allowing consumers to use energy in ways or at times that avoids drawing power at peak-load times and decreases use overall.

One example is a yearlong demonstration project by the Pacific Northwest National Laboratory on the Olympic Peninsula. Touted as one of the best smart grid projects in the country, the lab used automated thermostat controls and computer chips in clothes dryers and water heaters to respond to real-time pricing signals received from the electrical grid. The 112 participants included in the study were able to set their preferred-use settings — from the most energy saving to the least — on an Internet portal.

Peter Christensen spoke recently at the Society of Environmental Journalists' annual conference about the lab's project and electric grid management. Christensen manages the energy portfolio at the Pacific Northwest National Laboratory, which is a Department of Energy research lab. His previous experience includes strategic planning for intellectual property management and work as a patent attorney and as a consultant on electric power markets for large industrial users.

Miller-McCune caught up with Christensen after the conference to explore the concept and what it might mean to consumers, utilities and appliance manufacturers.

Miller-McCune: Could you briefly describe the lab's findings in the Olympic Peninsula project?

Peter Christensen: The premise was to evaluate the ability for a customer to respond to a real-time pricing signal. Part of the program was also to test some technologies that we had developed that allow that to happen. One was the technology in the appliances themselves that could respond to the real-time pricing signal but also the algorithm system that was set up on a software basis to operate this system. Obviously there were many published results. The primary results were that on average, over the one-year program,

customers saved about 10 percent of their electrical bill, which raises the issue, is that enough to incentivize customers to do that? That can be yes or no. By far the biggest impact was finding we were able to reduce peak demand by up to 15 percent during the highest peak times, and for a utility system, that's an enormous impact.

M-M: That would seem to be a real boon to utilities. Why aren't we hearing more about this?

PC: In our industry, there is a lot of talk about it. … Demand response and smart grid is getting a lot of discussion among regulators and legislators, too. The word is out.

I think the reasons why it hasn't gotten so much attention in the popular press is it's rather difficult to explain. People's eyes start glazing over when you talk about how their dryer is responding in a demand-response system. The Department of Energy followed up [earlier support] with a $650 million program funded through stimulus funds to have 16 large-scale smart grid demo programs around the country. We are participating in two programs — one in Columbus, Ohio, and another in the Northwest.

M-M: Could you tell our readers what demand response means?

PC: Demand response is using some sort of technology that will automatically reduce the amount of load on specific appliances in response to certain signals, either because the grid is stressed or because the price has gone up. It's basically a means for reducing demand on an electric system automatically in times of high prices or great stress on the grid.

Demand response is one component of smart grid. The DOE has seven different classes of technology that they lump together as smart grid. Not all of it is on the consumer side. Some of it is using new communications and IT for managing it from the utility side.

M-M: Since utilities earn money on a guarantee of fixed assets and utilities build for peak power, could smart grid be a disincentive for utilities?

PC: You could argue that both ways. There are different ideas around demand response. Frankly, I think a lot of utilities would welcome a reduction in their peak demand — not so much because they're worried about their rate of return against their fixed assets, but because it's so difficult to add capacity these days. If they do have a big increase in their demand — let's say electric vehicles start taking off in their area — it's far, far easier to have that peak levelized and manage the peak than it is to try to fight [for] a new power plant or new transmission line. That is extremely difficult and time consuming. They face risks with that, too. Utilities have not always been successful in recovering those kind of large investments.

The reason they are being slow to adopt it is primarily because it's a relatively new kind of paradigm — new meters, a new kind of relationship with their customer. It's new to them, and it's new to the regulators. Utilities are 100 percent regulated in most jurisdictions. You have to look at both regulators and utilities when it comes to why things aren't happening.

M-M: Xcel Energy's pilot project in Boulder, Colo., has run into cost overruns reportedly because of the cost of fiber optic cable, and there have been rate increases. Do you see problems like this emerging widely?

PC: I can't really comment on that. I'm unfamiliar with what's going on with Xcel. I've heard no other reports of large cost overruns with these smart grid programs, but they're early on in their deployment. There is cost to it. Right now the cost is being born by DOE in most of these programs. I think in almost all cases, the utilities and states are also asked to pony up some money.

M-M: Other programs in California have used time-of-use programs. How do these programs compare to the PNNL project?

PC: There's a lot of that around the country, especially in California. It's basically a very crude approach to demand response where you have a broad period of time when rates change. You're asking the end-user, without automated equipment like we are using, to respond to that knowledge — say, that the rates are going to be lower at night — so they are incentivized to install timers or wait until after the time period to run their dishwasher. It's the same approach but a much, much cruder way of doing it. That's why there was so much interest in what we found in the Olympic Peninsula demonstration. We got a much better response when it's automated and the end-user doesn't have to worry about it. That basically proved the point that — there's a term for it — it's consumer fatigue. After a while, people get tired of having to think about it. That was one of the big findings of that study.

M-M: You spoke at the conference about there coming a time when our clothes dryers will actually be interfacing directly with the electrical grid. I'm wondering how a dryer might "bid" for power. How would it know that power would be less expensive, for example, in an hour?

PC: Actually, it can. We are looking at some things that are predictive models. The price of power cycles, but that cycle is pretty consistent from day to day. We know the utility is going to peak at 5 p.m. We know it's going to have a lull at 2 in the morning. We are looking at some modifications to our algorithm that would be predictive, but that's not a key part of our program.

The dryer does nothing more than say I need so many kilowatts because I want to run. There's an algorithm that's in the system that looks at the price of power on a relative scale and there's a factor in the algorithm. It's a surprisingly sophisticated algorithm that determines when that dryer is going to respond.

In the demand response that we did with the clothes dryer, it only interrupted if it was running. It turned off the heating element for five minutes. After five minutes, it will turn back on. So if you set the dryer for 45 minutes, it will take 50 minutes to dry your clothes if it responded during the time you had it on. That is one of the counterintuitive results of the study. [People say,] "You mean, just by turning the dryer off for five minutes it had that big an impact?" That was one of the surprising results — even doing something very subtle that was almost transparent to the end user we were able to get significant results.

M-M: There have been some privacy concerns related to use of the Internet for smart grid connections in residential homes. Do you see this as a major problem?

PC: One of the criteria for the smart grid demonstration programs from DOE when they sent out their request for bids was that you had to submit a cybersecurity plan to address that very issue. None of the programs got accepted unless they had a detailed cybersecurity plan. There are a number of groups that are working on standards for cybersecurity for smart grid devices. We're probably still in the VHS-beta stage where there are different approaches, and what protocol is going to win is uncertain. It's being addressed in parallel.

M-M: If consumers are only likely to see a 10 percent decrease in their electrical bill, and there's basically no incentive for appliance manufacturers, why would these sectors be interested in smart grid?

PC: That's one of the big debates among the smart grid people: What level of incentive is required for someone to drive down to Home Depot and buy one of these things for their house? Or pay extra for a dryer that has that feature? I certainly don't have the answer, and I'm not sure anyone does. That's why I'm advocating getting all the stakeholders — the utilities, regulators, legislators, consumer advocates — together to basically work out a system where those benefits are equally shared.

There is a consensus in the industry that the bulk of the benefits of smart grid accrue to the utility. I don't know if anybody could argue that. And if that's the case, how do we make sure those benefits are shared by everybody, including the manufacturers? They've got to be incentivized, too, to spend that extra $5 to put that functionality in their appliances. We have to come up with a system either through rebates or mandates or standards. We have a standard with Energy Star appliances. It could be that to get that rating, an Energy Star appliance would have to include that smart grid technology. That's one way of getting there.

The appliance manufacturers have been very supportive and they've been more than happy to participate in these different experiments because they want to be ahead of the game. There's a marketing value to being the first smart grid green appliance out there. But they're not going to do anything in a major way until there's some certainty that what they use is going to be used widespread.

The most common approach is having all the intelligence reside in a specific device. Basically, the dryer, for example, would have an input rather than having all the intelligence.

M-M: What sort of device would hold the intelligence?

PC: It would be in some device in your home. It could be part of your thermostat on the wall with a screen that you could use to control all the appliances in your house. There are also companies looking at putting out widgets that go, say, on your television. You turn on your TV, press a button on your remote and up pops a window on the lower left-hand corner that has all your energy management settings on it. You could control it from there, and all the intelligence resides within your TV. There's a company doing that. Or it could be something that runs on the computer. There are lots of people looking at doing apps on your iPhone. You could actually control your washing machine through your iPhone remotely if you wanted to.

Everybody and their grandmother has a different idea about how to do it, and the market will determine who wins. The way it's heading is probably some sort of device similar to a thermostat. And there will have to be some sort of portal to provide communication back to the utility.

M-M: If you could envision a regulatory and incentive system to support smart grid, what would it be?

PC: I'm hesitating a little because every state has its own regulatory structure. In the West, generally, most of them are pretty traditional. On the East Coast many states — Pennsylvania, New England [states] — have more of a restructured approach to electric energy. They vary tremendously, depending on the jurisdiction. But in a traditional market like we have out West — basically a vertically integrated utility — what I would envision is some sort of tariff that the regulators establish with utilities that provides for that pricing signal to be sent and received by the device so it could respond appropriately, with some sort of reportable savings that would be returned to the consumer that's more than just what they save on their kilowatt hours. In other words, the more they participate the greater the benefit.

The benefit to the utility is in that reduced demand. It's not just in the kilowatt hours saved. You could argue there's not any kilowatt hours saved. You're just shifting the load. You're not running your dishwasher less; you're just running it at a different time. You're saving the utility money by operating at a lower cost time. So there would have to be some part of the tariff that would reflect that and there would be enough of the sharing of the benefits such that it provides those proper incentives for most customers to participate. I guarantee that no matter how wonderful we make this system and how much incentive there is to the end user, there will always be people who don't want to play. But it doesn't take everybody.

M-M: Will smart grid help with distributed electricity generation such as residential rooftop photovoltaic solar cells?

PC: It can help to some degree with respect to peak loading because it's putting generation next to load so it reduces transmission requirements, although you still have that intermittency [with solar and wind].

If you have a demand response system in place it can facilitate intermittent generation better because when there is excess generation from those intermittent sources, you would be using your appliances to the fullest. Then when a cloud passes over your solar panel or the wind stops blowing, the demand response system can respond instantly to that — shut off your dryer, turn off the water heater for a while until the cloud passes. It allows your demand to contribute to balancing [the intermittency] rather than relying on the grid to do that.

M-M: You noted at the conference that utilities are generally conservative by nature. Do you think results from demonstration projects like PNNL's are likely to motivate them to get going with smart grid?

PC: I think they will adopt it — even happily adopt it, for a number of reasons, including that it's a better way to accommodate electric vehicles. They're going to see having electric vehicles on the grid is a good thing. … If the regulators and the utilities are in the same room and they say yes, this is good —which I think they already are doing — then it's going to happen. But it absolutely can't happen by each party doing it by themselves. It's got to be everybody rowing in the same direction, all the oars in the water at the same time. The way the utility-regulatory system is set up is so complex that no one party can do it by themselves.

M-M: You've talked some about how electric cars could be charged using smart grid technology and the effect powering lots of electric cars would have on peak load. Could you elaborate?

PC: We have enough capacity in the system — enough transmission lines and generators — to serve up to 73 percent of light-duty transportation with existing capacity. But you've still got to create the energy. You're shifting that load to times when it's already underutilized. Your generators are spooled down at night and those transmission lines don't have a lot of capacity. Basically, you're flattening out that load curve by putting all the transportation load during nonpeak time. But you still have to generate the electricity. That's why some people still claim that you're burning fossil fuels for electric cars. Of course, what we're hoping to do is generate that with excess wind power.

I tend to be pretty bullish on electric cars. I think people are going to realize their operating cost is very, very low compared to gasoline. … I love that picture on the website of the Nissan Leaf where they show the back of the car — simply because it's obvious there's no tail pipe. How cool is that? You could drive it in your living room, right?

Just from a distribution standpoint, if you live in a neighborhood with a typical pole-top transformer or a green box that feeds five to 10 houses, what happens if all five people on a pole-top transformer decide to buy electric cars at the same time? Especially now before all these demand response and intelligent charging technologies are deployed. You're going to blow up that transformer. If [electric cars] catch on quickly, utilities will have to scramble to keep up with them purely from a distributional and wire standpoint.

If that's our problem, we're doing pretty well. As I said at the conference, the lab's mission statement from DOE is to reduce our dependence on foreign oil. If our only problem is we've got to build more distribution circuits because of all the electric cars we're going to use, that's a problem I'm looking forward to.

http://www.miller-mccune.com/environment/empower-your-appliances-with-the-smart-grid-27518/

Combining Heat and Power

An old American idea to capture and use waste heat from electricity generation, adopted by Europe, needs to come back home for a visit.

By Michael Scott Moore

Waste heat from electricity is an idea whose time is coming around again. Invented here by Thomas Edison, Europe has adopted it, but the U.S. needs to consider its usefulness again. (Asif Akbar / stockxchange.com)

One of the most unexciting but obvious ideas for cutting pollution and making a nation more energy-independent is a simple concept called "combined heat and power," known as CHP or cogeneration, which traps heat from a power plant and sends it around to local buildings as, well, heat.

The technology started with Thomas Edison, but the European Union has surged ahead of America in putting it to use.

Power plants give off huge amounts of heat as a by-product of burning coal, oil or gas to move turbines. "Cogeneration" plants just install the necessary pipes to catch and recycle the heat. It can be used to heat buildings or gin up more electricity.

European countries have invested heavily in cogeneration because of the EU's goal of slashing greenhouse-gas emissions by 20 percent (from 1990 levels) before 2020. The EU passed a mild directive in 2004 to spur its members to build more cogeneration plants, but the leading countries in Europe, like the Netherlands and Denmark, have developed combined-heat-and-power systems out of pure self-interest.

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

Denmark started to use cogeneration seriously in the 1970s, when the energy crisis drove up the price of oil. It moved away from oil-fired power plants and back to coal, but it also replaced individual coal- or wood-burning stoves with "district heating" systems that carried extra heat from the coal plants around to local houses and buildings. Property owners in those areas had no choice — they were ordered to join the district-heating schemes. But now Denmark heats around 80 percent of its buildings with "waste heat" — including from solar — and derives some 40 percent of its power from it, too.

The U.S. evolved in the opposite direction. Because it was easier to electrify the vast American countryside from huge regional utilities instead of from smaller, "district"-sized plants, it became illegal, in some states, to compete with the big monopolies. Without smaller plants, recycling heat wasn't practical. Laws changed in the 1970s and '80s, but the U.S. still lags.

The average American power plant generates electricity equivalent to about 33 percent of its fuel and wastes the rest in heat. Cogeneration plants run at 60 percent efficiency rates and sometimes much higher. The Department of Energy is on the case, nominally; it wants to raise the country's share of CHP-generated power to 30 percent — well under Denmark — by 2030.

This is embarrassing, since Edison pioneered the technology. In 1882, he designed the first commercial power plant — a cogeneration plant — on Pearl Street in New York City. New York in the meantime has the United States' largest and most venerable recycled-steam system, which lets the city's power plants warm (or even cool) Manhattan high-rises.

Washington, as a rule, doesn't legislate big change (health care being a notable exception), so the main federal incentive to build more of these plants lately has been a tax credit to the tune of 10 percent on CHP investments. That hasn't caused huge change across the land. A bill that would kick the incentive up to 30 percent stalled in Congress last year.

Cogeneration is also a ripe area for smart government stimulus, since the elements of a heat-recycling system — ventilation, exhaust and heat-exchange components — are, or can be, built in the United States. The Department of Energy did hand out $156 million for cogeneration technology as part of the Recovery Act in 2009. But compared to the billions shoveled into banks for so-called "quantitative easing" in 2008 and 2010, those DoE grants sound more like an afterthought.

http://www.miller-mccune.com/blogs/european-dispatch-blog/combining-heat-and-power-26830/

Thoreau Was Right: Nature Hones the Mind

Studies show nature restores our spirits, improves our thinking, keeps us healthier and probably even saner.

By John McKinney

"Attention Restoration Theory" posits that a walk in the woods helps refocus the mind and revive the spirit. (GanMed64/Flickr.com)

A long line of the world's thinkers — from Immanuel Kant to William James to Deepak Chopra — have recommended we take walks in nature to relieve stress and refocus our thoughts. And nature writers — from Henry David Thoreau to John Muir to Edward Abbey — have extolled the restorative benefits of nature. "Everybody," Muir said, "needs beauty as well as bread, places to play in and pray in, where nature may heal and give strength to body and soul."

Turns out they were ahead of their time. "Attention Restoration Theory" or ART, which posits that a walk in the woods helps refocus the mind and revive the spirit, has been a growing field of research for the past 20 years. New studies are quantifying the restorative powers of nature and suggesting how the restorative process works.

"In the late 1980s, I discovered that 'favorite places' could be a good window [measurable unit of analysis] into how humans use their environment to restore themselves," states psychologist Kalevi Korpela with Finland's University of Tampere.

Korpela's most recent study questioned some 1,273 city dwellers of Helsinki and Tampere, aged 15 to 75 about the restorative experiences of their "favorite" places. Residents identified their favorite restorative places and what they perceived as the health benefits of visiting them.

The self-rated restorative benefits gained by venturing into the woods and along natural shorelines — "an early-morning walk is a blessing for the whole day," as Thoreau said — were judged as significantly stronger than ventures to other favorite places in the city, including developed parklands. The results revealed links between the need for restoration (relief from worries and stress about money, jobs and the hectic pace of modern life) and the use of favorite places — what the social scientists call "environmental self-regulation strategies" — to achieve restorative benefits.

The more worries (particularly about work and money) an individual had, the higher the typical level of restoration experience, and the more reported benefits gained from getting out into nature. Unfortunately, those with many worries had a low rate of nature trips and consequently received a lower level of restorative benefits.

"This inconsistency surprised us," Korpela says.

As social scientists explain it, nature engages your attention in relaxed fashion — leaves rustling, patterns of clouds, sunsets, a bird, the shape of an old tree. Nature captures our attention in subtle, bottom-up ways and allows our top-down attention abilities a chance to regenerate. Attention, therefore, is "restored" by exposure to natural environments.

But the artificial world, like a downtown city, demands active attention to avoid getting hit by cars, negotiate lights and intersections and navigate around others on the sidewalk. At the same time, city walkers are bombarded by advertisements, traffic and noise. The high-demand attention required when negotiating crowded city streets offers no rest for the weary mind; in fact, it's similar to the intellectual requirements demanded of office workers or of college students.

Nature's value in the recovery from illness has been quantified repeatedly. Studies have shown that post-surgery patients resting in rooms overlooking trees recovered better and faster than those in rooms with a view only of a brick wall. Another study demonstrated that women with breast cancer who walked in a park, watched birds or tended gardens recovered more quickly and were in better spirits than those with little or no contact with the natural world.

The cognitive benefits of nature — even if it's just a hint of nature like a poster or a potted plant — are many and have been tallied by a number of recent studies. University of Michigan researchers Marc Berman, John Jonides and Stephen Kaplan wanted to quantify the effects of ART. Students were given long tests of sequences of numbers to repeat in reverse then sent on walks — half the study participants on a nature walk and half on a city walk. Upon re-testing, the nature walkers' scores improved significantly while the city walkers' did not. The experiment was repeated so that each student walked in nature and in the city, and everyone's score was better after the nature walk.

Researcher Gary Felsten wanted to know the most restorative locations for study breaks and decided to ask students at the University of Chicago, a venue both academically intense and far removed from nature. Felsten took pictures of various lounge areas overlooking urban scenes and other buildings, others looking out on restful natural scenes. For some windowless lounges, he used computer software to place murals of natural scenes onto their empty walls.

Students were asked to rate the lounges for "a sense of being away" and other qualities considered by ART as "restorative." Students rated the lounges with both artificial and real views of nature as more restorative than views of the city.

Researchers around the world have shown that windows looking out on nature scenes deliver significant restorative results and are now inquiring about the possible benefits of "virtual" nature. Can technology in the

form of nature scenes on a high-definition plasma screen provide a restorative "nature fix?" Researchers from the University of Washington's Human Interaction With Nature and Technological Systems Lab got mixed results from two studies: One study showed plasma nature windows providing low-level restorative benefits, another study showed them no more restorative than a blank wall.

One result of all of this research is that recognition of nature's mental and physical health value is now part of public health discussions. And ART research has helped legitimatize eco-psychology, long stereotyped as New Age philosophy and now seen as grounded in science and statistics.

If further research shows that people deprived of nature will display behaviors characteristic of fatigued attention and irritability, how should office buildings be designed? Schools? Neighborhoods?

Korpela sees the need for more studies about the use and effectiveness of natural and other favorite places in helping people regulate and reduce the stresses of everyday life.

"How do people use different kinds of places to ameliorate stress, reflect on personal matters, to regain and reflect on their identity?"

Korpela believes the restorative value of nature can be taught to today's stressed-out city dwellers. Under his direction, what is likely "the world's first forest trail with psychological signposts enhancing the restorative experience" was constructed recently near Ikaalinen Spa, one of Finland's largest. Hikers meander through diverse scenery and get trailside signpost instructions aimed at increasing the restorative experience: inducing reflection, relaxation and improving their moods.

Researchers will continue to quantify the amount and kind of nature we need to restore our spirits and regain our mental acuity. In the meantime, it appears Thoreau was right: "We can never have enough of nature."

http://www.miller-mccune.com/health/thoreau-was-right-nature-hones-the-mind-26763/

High-Fructose Corn Syrup's Health Risks Remain Sticky

The need for a long-term study hinders what we know about high-fructose corn syrup.

By Taylor Orr

High-fructose corn syrup isn't well loved in health circles, but it is well consumed everywhere else. Despite that fact, the jury's still out on its potential health risks. (Rex Sorgatz / flickr.com)

High-fructose corn syrup generally gets a bad rap by the health community. The sweetener has been blamed for everything from obesity to diabetes, heart attack to stroke. But what do we really know about it?

During the 1970s, the American food industry introduced high-fructose corn syrup, or HFCS, as a sweet substitute for sucrose (which we recognize as table sugar). Processed from corn — it gets its "high-fructose" name because its fructose content is higher than the corn from which it originates — the syrup contains about the same number of calories as sucrose or honey but has a greater shelf life. It's also far cheaper than sugar, which has helped beverage manufacturers keep prices low.

The additional shelf life was a boon for processed foods, and, as a result, HFCS can now be found in just about every packaged item in the grocery store. From cookies to bagels, it's nearly replaced sucrose in sweetened goods, although its real forte has been in liquids: Nearly two-thirds of all HFCS in the United States are found in beverages, namely soda.

(There are two types of the sweetener: HFCS-55, composed of 55 percent fructose, 42 percent glucose and 3 percent glucose polymers, used in soft drinks, and HFCS-42, which is 42 percent fructose, 53 percent glucose, and 5 percent glucose polymers, used in baked and processed goods.)

Although sugar's availability has increased in the U.S. food supply since HFCS was introduced, the growth of corn sweetener is proportional to the growth in food supply.

That ubiquity has come at a price, and now having been vilified by the health conscious community as a source of obesity, diabetes and a slew of other problems, the Corn Refiners Association has lobbied to rename HFCS as "corn sugar" in an attempt to "enable consumers to easily identify added sugars in the diet."

Some products, such as Wheat Thins, Gatorade, Hunt's ketchup and Kraft salad dressings, no longer include HFCS as an ingredient in an effort to avoid the HFCS backlash. Even beverage manufacturers like Coca-Cola tout "imported" versions of their sodas from Mexico that use cane sugar and not HFCS.

Although making the change may work wonders for public relations, will replacing HFCS with sugar change consumers' health?

During the last several years, scientists have had widely different results in testing whether HFCS reacts differently in the body compared to sucrose. Some researchers suggest there's something special about HFCS that fosters obesity and the rapid weight gain and health failures of Americans during the last few decades.

A 2004 study postulated that fructose does not stimulate insulin production or enhance leptin production, unlike its cousin glucose, which is naturally found in fruit. Leptin and insulin are key hormones in the regulation of appetite and metabolism. Authors at Louisiana State University's Pennington Biomedical Research Center, led by George Bray, reported that "because insulin and leptin act as key afferent signals in the regulation of food intake and body weight, this suggests that dietary fructose may contribute to increased energy intake and weight gain." In short, the more HFCS you consume, the more HFCS you may want to eat.

Thus, "the increase in consumption of HFCS has a temporal relation to the epidemic of obesity, and the overconsumption of HFCS in calorically sweetened beverages may play a role in the epidemic of obesity."

Another study found that when people were given HFCS-sweetened beverages, they gained significantly more weight than when they consumed the sugar (in the form of jelly beans). While jelly beans aren't exactly a key component of a balanced meal, the study demonstrates people are generally more aware of the calories they eat rather than those they drink.

In a study by Princeton researchers last year, psychology professor Bart Hoebel noticed a disturbing trend in HFCS consumption. "When rats are drinking high-fructose corn syrup at levels well below those in soda pop, they're becoming obese — every single one, across the board. Even when rats are fed a high-fat diet, you don't see this; they don't all gain extra weight."

Why? Nicole Avena, assistant research professor at the University of Florida who collaborated with Hoebel on HFCS research, said that although HFCS and sucrose are chemically similar, the greater amount of fructose found in HFCS could lead to considerable differences in the metabolic processes within the human body.

She explains the complicated process: "Fructose is absorbed further down the intestine than glucose, with much of the metabolism occurring in the liver. Fructose is metabolically broken down before it reaches the rate-limiting enzyme (phosphofructokinase), thereby supplying the body with an unregulated source of three-carbon molecules. These molecules are transformed into glycerol and fatty acids, which are eventually taken up by adipose tissue, leading to additional adiposity," i.e. beer bellies and thunder thighs.

Circulating glucose, on the other hand, "increases insulin release from the pancreas." Fructose does this less well because cells in the pancreas lack the fructose transporter.

Regardless, she added, "Too many calories, regardless of where they come from, can be detrimental to health and promote obesity."

(Oddly enough, efforts to avoid calories may backfire. Consuming Splenda and other zero-calorie sweeteners may cause people to eat more than they normally would. Whether this is psychological, a person thinks they

can over-consume calories because they saved 140 HFCS calories picking a Diet Coke over a Coca Cola, or a physiological response unique to a zero-calorie sweetener, is yet to be proven.)

But not all the research supports a malign role for corn syrup in the first place.

Stijn Soenen and Margriet S Westerterp-Plantenga at the University of Maastricht argue that "the replacement of sucrose with HFCS in beverages plays a causative role in obesity is not supported on the basis of its composition, biologic actions, or short-term effects on food intake."

In a study by the *American Journal of Clinical Nutrition*, participants' insulin and blood sugar levels were measured upon eating food containing either HFCS or sucrose. The study's authors determined that "sucrose and HFCS do not have substantially different short-term effects on endocrine signals involved in body-weight regulation." The way the body metabolizes HFCS and sucrose are similar enough that HFCS does not uniquely cause people to gain weight, compared to sugar.

The biggest issue with nailing down whether HFCS is a hero or villain is the lack of a long-term study. Because HFCS was only introduced into the diets of millions of Americans in the 1970s, scientists have not had enough time to determine whether HFCS is inherently good or inherently bad in the American diet.

Major roadblocks exist to producing long-term studies with definitive answers about HFCS's potential health risks. For a well-controlled study, participants would have to eat a highly restrictive diet controlling for the amount of HFCS in the diet, as well as other food groups to produce accurate results about how HFCS interacts in the body.

A nagging question remains: Consume HFCS freely or avoid it completely? Perhaps it is prudent to consider the foods in which HFCS is predominantly found: soda and processed foods. Both tend to be void of fiber, antioxidants and other key nutrients. Eating a diet rich in whole foods that limits both table sugar and HFCS may be the best nutritional bet.

http://www.miller-mccune.com/health/high-fructose-corn-syrups-health-risks-remain-sticky-27633/

Statins, Lou Gehrig and Big Questions

The cholesterol-lowering drugs known as statins have proved remarkably popular, but might they contribute in a few cases to debilitating neuromuscular disease?

By Judith Reitman

While a connection between ALS or ALS-like illnesses and the cholesterol-reducing medication seems increasingly plausible, the debate is fierce — in large part because the stakes are high. (claudiobaba/istockphoto)

Dr. Greg Burns (not his real name) is a 72-year-old retired radiologist living in Connecticut. Until early last year, he ran with his dog at canine agility meets, skied, ice skated and played 18 holes of golf. He is now unable to walk and is taking a course of medication that will postpone, by a few months, his death.

Burns' rapid decline began in December 2007 when he suffered a short-acting stroke from which he fully recovered.

His cholesterol level was elevated and so as a preventative measure his doctor prescribed a 20mg daily dose of Crestor, a cholesterol-lowering drug in the "statin" class. Statin drugs are designed to inhibit cholesterol synthesis, and about 20 million people are taking statins, most for life.

A few months after beginning Crestor, Burns developed muscle cramps. He was assured by his doctors that these were not serious side effects of taking the drug. But in December 2008 when tests showed that his creatine phosphokinase — an enzyme that is released into the blood stream when muscle cells are damaged — was elevated, Dr. Burns stopped taking Crestor. When his enzyme levels returned to normal, he began taking Pravachol, another statin drug. He quickly developed weakness in his lower legs and a right foot drop. In January 2010, following an extensive neurological exam, Dr. Kevin Felice at The Hospital for Special Care in New Britain, Conn., diagnosed Burns as having amyotrophic lateral sclerosis or ALS, commonly known as Lou Gehrig's Disease.

ALS is a fatal, progressive neurodegenerative disease that affects lower motor nerve cells in the brain and the spinal cord. Muscular paralysis ultimately reaches the respiratory system and, when that happens, the patient will die if not placed on a respirator. This, however, is only an interim measure. The average life expectancy from the time of diagnosis is two to five years.

Burns attributes his condition to the statin drugs. Mayo Clinic cardiologists acknowledge that the side effects of statin drugs can include muscle pain, extreme fatigue, liver damage, digestive problems and neurological damage including memory loss. While a connection between ALS or ALS-like illnesses and the cholesterol-

reducing medication seems increasingly plausible, the debate is fierce — in large part because the stakes are high.

The drugs account for a significant percent of all cardiovascular medications, and are the largest-selling class of prescription drugs (and are available over-the-counter in the United Kingdom). Crestor, made by AstraZeneca, ranks second to Pfizer's Lipitor, the biggest seller.

The FDA has expanded the consumer base for drug companies that are marketing statins. In March 2010, the agency revised its guidelines for prescribing statins based on evidence of inflammation in the body, this despite debate over whether inflammation is indicative of high cholesterol. The criteria also factors in the presence of at least one risk factor like smoking or high blood pressure for people older than 50. This expansive criteria, which FDA approved for Crestor, makes about 6.5 million people who have no cholesterol problems or evident heart problems candidates for taking statins.

A small but urgent chorus has long wondered if statins are overused.

This week, new research from the London School of Hygiene & Tropical Medicine suggests that the research underlying statin drugs may have been "cherry-picked" to present the best possible outcomes, and that statin drugs may be inappropriate for low-risk patients.

A significant relationship between muscle toxicity and statin drugs was confirmed in a study published in the *American Academy of Neurology* in 2002. Danish epidemiologist David Gaist found that "long-term exposure to statins may substantially increase the risk of polyneuropathy," a neurological disorder that occurs when peripheral nerves throughout the body malfunction simultaneously. Gaist cautioned against throwing the baby out with the bathwater, however, noting "the substantial protective effect of statins, particularly on coronary artery disease, is well documented and by far outweighs the potential risk of statin-induced polyneuropathy."

Sometimes the negative side effects of statins are downplayed, and conclusions can be skewed by the limited parameters of the trials. As a 2007 Scripps Mercy Hospital study noted: "The incidence of statin-induced rhabdomyolysis (acute breakdown of skeletal muscles) is higher in practice than in controlled trials because of the exclusion of potentially susceptible subjects."

Also complicating matters is how ALS is defined. Dr. Ralph Edwards, director of the World Health Organization's drug-monitoring center, told me that U.S. Food and Drug Administration's definition is too limiting. "The FDA uses a classic description of ALS which may not pick up all the cases, despite our emphasis that any study ought to think more widely about a condition that is seriously disabling and may also lead to death."

In 2007, the year of the Scripps study, Edwards found evidence that statins may be linked to an illness not typically defined as ALS: "It was an odd condition that was a mix of muscle and neurological damage which did not fit the classic ALS definition but could result in mortality."

This side effect alarmed Edwards so much that he made his suspicions known to the FDA. The government responded by asking the drug companies to examine their pre-marketing clinical data relating to statin and ALS. The FDA also reviewed the outcomes of 41 pre-marketing trials conducted by the drug companies. It concluded that the data was "reassuring" about statin safety.

Edwards was not reassured. He conducted his own research, but both *The British Medical Journal* and the *Lancet* rejected his paper. It was published in 2007 in the specialty journal, *Drug Safety*.

In 2008, the *American Journal of Cardiovascular Drugs* published a metastudy citing nearly 900 studies of statins' wide-ranging adverse side effects. The next year, the lead author of that piece, Dr. Beatrice A. Golomb, published her own research from the University of California, San Diego, on "Amyotrophic Lateral Sclerosis-Like Conditions in Possible Association with Cholesterol-Lowering Drugs." She noted: "An excess reporting of ALS in apparent association with lipid-lowering drug use was identified in our patient-targeted AE (adverse effect) surveillance study, prior to the corroborating reports of others, providing independent affirmation of elevated reporting."

While falling short of making the direct link between statins and ALS, Golomb raised significant questions. Do statins increase ALS overall? Do statins accelerate ALS, hastening its clinical presentation or progression in general or only in individuals where statins have oxidant effects? She suggested the "testable possibility of an identifiable vulnerable subgroup, an observation of high potential importance."

University of Oxford researchers funded by the British Heart Association took up the challenge. Their study represents the first time the complete human genome has been scanned to locate the genetic culprit of a drug's side effect. The culprit turned out to be a mutation, a sort of rogue gene that boosts the risk of myopathy caused by taking statins. The Oxford team determined that this variation in the DNA code of a gene called SLC01B1, which helps the liver regulate statin uptake, was responsible for 60 percent of the myopathy in people taking high-dose statin therapy. Patients on high statin doses who carry one copy of the rogue gene were at least four times more likely to develop myopathy than those without the gene. Patients who carried two copies of the rogue gene were 16 times more likely to develop ALS. Astonishingly, 1 in 4 people carries one or two copies of this rogue gene.

"This is very exciting," Edwards said. "They made that link between statins and myopathy and ALS, two critical conditions that are definitely related to each other."

The classic definition of ALS excludes illnesses and symptoms linked to taking statins, making an exact count of who has the disease — based on symptoms alone — difficult.

More than 5,000 individuals in the U.S. are diagnosed with classic ALS annually, and at least 30,000 may be now living with ALS. With the recent establishment of a National ALS Registry, those figures may prove low.

There is no cure for ALS. Rilutec, the only FDA-approved medication for treatment, simply postpones death by a few months. Recently a drug tested by Cytokinetics showed some favorable results in small-scale trials. However, like Rilutec, it does not reverse the illness nor cure the nerve damage, and it is not yet on the market.

Nine months after his diagnosis, Greg Burns' speech became slurred. By year end 2010, paralysis set in. He has begun taking Rilutec.

http://www.miller-mccune.com/health/statins-lou-gehrig-and-big-questions-27449/

Evidence Menu Labels Don't Affect Calorie Consumption

The latest look at fast-food menu labeling suggests it's not changing attitudes at the counter, but experts hope it may make a difference earlier in the decision chain.

By Michael Todd

Researchers studying Taco Time restaurants in Seattle found that the number of sales and average number of calories purchased were the same at eateries with nutrition data as at eateries without. (litlnemo/Flickr.com)

Having made a decision to dine on fast food, additional information about the composition of its delights doesn't seem to affect decisions about what to enjoy. That's the takeaway message from a new but limited study drawn from Taco Time restaurants in the Seattle area.

Researchers led by Duke-NUS Graduate Medical School's Eric A. Finkelstein examined the impact — or lack of it — of mandatory menu-labeling laws. They found that the number of sales and average number of calories purchased were the same at eateries with the data as at eateries without.

Usually citing alarming statistics about obesity in America, a number of regional governments have considered or even implemented such requirements, and the U.S. government expects to release its own regulations on fast-food menu labeling by March 23.

The concept that rational people will make better nutritional decisions if they have pertinent facts in front of them is certainly an attractive argument, and there's been some evidence that it makes a difference. In another Seattle-based study reported by our Elisabeth Best ("Information: The New Weight-Loss Drug"), for example, parents chose less calorie-laden Happy Meal items for their kids when presented with calorie data.

But other studies have suggested people don't even see the posters or pick up the pamphlets that describe the culinary crimes they're about to commit. Two years ago, Ryan Blitstein wrote that "just 0.1 percent of customers visiting restaurants like McDonald's and Burger King actually look at the nutritional content." ("Would You Like Nutrition Info With That?") As Yale's Christina Roberto told him at the time, "My hypothesis was that it'd be a small number. I just didn't think it would be that small."

That same sort of letdown was evident in Finkelstein's reaction, as quoted in a release accompanying the study in the *American Journal for Preventive Medicine*. "Given the results of prior studies, we had expected the results to be small, but we were surprised that we could not detect even the slightest hint of changes in purchasing behavior as a result of the legislation. The results suggest that mandatory menu labeling, unless combined with other interventions, may be unlikely to significantly influence the obesity epidemic."

One of his co-authors, Kiersten Strombotne, suggested that fast-food patrons have already made their choices by walking in. "For example," she was quoted, "if you know a store offers diet and regular soda, does showing how many calories are in regular soda really offer any relevant information? Those who want a lower-calorie drink already know to drink the diet soda."

In short, "it may be that detailed nutritional information is not the best way to convey the health content of fast foods."

But last May, our Joanne Kenen, in "Restaurant Menu Labels Can Make a Difference," argued that "giving diners more dish on their diet has a modest but detectable impact." Her story looked in part at New York City, where officials compared receipts before and after menu labeling was instituted. (The Taco Time researchers compared sales at seven restaurants sporting the labels with seven that didn't, and looked at the locations both before and after the regulation came into effect.)

But Kenen suggested a corollary effect that couldn't be measured in diners' on-the-fly decisions. Instead, benefits could appear before patrons placed their orders, such as improvements in corporate menu setting, portion sizes and even ingredient choice.

http://www.miller-mccune.com/health/evidence-menu-labels-dont-affect-calorie-consumption-27469/

Sexy News Anchors Distract Male Viewers

New research finds when a female news anchor's sexual attractiveness is played up, male viewers retain less information.

By Tom Jacobs

To capture male viewers, news networks have hired attractive female anchors. While it may boost ratings, studies show male viewers get distracted and remember less from the newscast. (dpstyles/Flickr.com)

Scholars, critics and viewers have noted that some TV newscasts can be momentarily mistaken for Victoria's Secret specials. In an apparent attempt to capture channel-surfing male viewers, stations have hired attractive female anchors, often outfitting them in attire that emphasizes their sexuality.

This strategy may boost the ratings, but in terms of the programs' purported purpose — informing the public — recent research suggests it has a definite down side. Males may be drawn to those alluring anchors, but they may not remember what they were talking about.

Two Indiana University scholars report that, for male viewers, "emphasis on the sexual attractiveness of female news anchors distracts from memory formation for news content." They found that "men's cognitive mechanisms favored visual over verbal processing," which is a delicate way of saying their focus — and subsequent memory — are more on the broadcaster's appearance than on the material she was delivering.

Writing in the journal *Communication Research,* researchers Maria Elizabeth Grabe and Lelia Samson describe the clever experiment that led them to this conclusion. They created two versions of their own short newscast, both of which featured the same 24-year-old female anchor.

For the first version, the broadcast journalist "was dressed in a tight-fitting dark blue jacket and skirt that accented her waist-to-hip ratio," they write. "She also wore bright red lipstick and a necklace." For the alternate version, she was dressed in "a shapeless and loose-fitting dark blue jacket and skirt," and wore no lipstick or necklace.

"The anchorwoman was framed in a medium-long shot to reveal her upper body, including her upper thighs, waist and hips," the researchers note. "The news stories were about local matters, including United Way fundraising, interest rate changes for federal loan programs" and the like.

The just under 400 participants were randomly assigned to watch one version or the other. All then filled out questionnaires summarizing their impressions of the reporter. They were also asked four multiple-choice questions about her physical appearance, and 10 multiple-choice questions about the content of the five stories she presented.

The researchers found the men recalled "significantly more information watching the unsexualized anchor deliver news than her sexualized version." For women, the opposite was true, but the effect was far less pronounced.

Looking at the data a different way, when the anchor had a desexualized appearance, men retained more of the information she presented than women. But when she was dolled up, the men's retention level dropped to the point where the two genders retained the same amount of content.

The study provides evidence for a basic theory of evolutionary psychology: When it comes to processing information, visual tends to trump verbal.

It also confirms something women have long suspected: A sexually charged image can flood the male brain, stimulating its visual processing component "to levels that demand close to full cognitive capacity."

This problem did not turn up in women in this study — but then again, they weren't responding to newscasts featuring muscular male models. While the results of that scenario are speculative, this paper offers one more reason why Fox News viewers are so ill-informed on so many issues. I mean, have you seen those photos of Megyn Kelly?

http://www.miller-mccune.com/media/sexy-news-anchors-distract-male-viewers-27562/

The Upside of Teen Pregnancy

Usually pictured solely as a scourge, pregnancy for unmarried poor teens may actually have some benefits for the mom.

By Richard Korman

One study shows early motherhood provides girls from the poorest neighborhoods a path away from delinquency and drugs and toward a better life. (digitalskillet/istockphoto)

Jenelle is a party-loving high school junior in Oak Island, N.C., with blond hair and a metal stud above one side of her mouth. Andrew is a slim, smooth-talking former model with a fondness for alcohol. They've been together three years.

Jenelle thought unprotected sex with Andrew would be OK because they'd tried it before and nothing had happened.

Now they've got a baby on the way, and Jenelle's determined to keep it and stay with Andrew, too. "We're in it forever now," she predicts.

For the stars of the first episode of the recently completed second season of MTV's reality show, "16 & Pregnant," you couldn't come up with two less-qualified parents. As they demonstrate their shallowness again and again — Andrew glibly blames his joblessness on the fact that "the economy sucks right now from depression" and Jenelle's only plan for the baby is that she'll show it a good time at the beach — you almost want to beg Jenelle to dump Andrew and give the baby up for adoption.

For 40 years, teen pregnancy has troubled policymakers and scholars. Researchers have associated children born to teenage mothers with lower birth weights, lower educational achievement and lower earnings. Pregnancy and motherhood also often interrupt both the mom's and the dad's schooling and career plans and mires the child in poverty.

Sarah Brown, chief executive of the National Campaign to Prevent Teen and Unplanned Pregnancy, has said part of the reason for the organization's creation in 1996 was that "too few Americans understood the central role that teen pregnancy plays in child poverty, out-of-wedlock childbearing and welfare dependency."

Federal funds go to support programs for broadcast messages encouraging men to use condoms and for counselors and teachers to discourage kids from having sex or to use contraception if they can't wait. Tax dollars also expanded Medicaid-subsidized contraception. All have proven cost effective, paying back many times the funds allocated in healthier, more prosperous and less troubled kids and families that will not need help from the government.

Partly because of such programs, from 1991 to 2008, teen pregnancy and birth rates fell by a third. About one out of five sexually active teen girls will become pregnant this year and 400,000 teen girls will give birth. While that represents progress, many teen girls and boys still misunderstand fertility and contraception, and the U.S. has the highest teen pregnancy rate of comparable countries.

Recent studies show why some teen girls may welcome pregnancy — and why it may be better for everyone if Jenelle and Andrew stay together.

For one, early motherhood provides girls from the poorest neighborhoods a path away from delinquency and drugs and toward a better life, one new study shows. It partly confirms what earlier qualitative studies have demonstrated for decades: For poor teen girls, pregnancy has an upside.

Either because of commitment to their babies or having to stay home at night, "motherhood is pulling a lot of these women away from the pattern of being criminal," says Derek A. Kreager, assistant professor in the department of crime, law and justice at Penn State University and co-author of the study.

He cautions that no matter how much good pregnancy may do for the moms, the babies born to these moms are more likely to have problems.

A second paper introduces a special series of articles on children and families, and it suggests a role for policymakers. With four out of five single mothers in committed relationships when they get pregnant, the authors write, the couples should undergo counseling on marriage and relationships to help keep them together.

"We believe that the birth of the child should be viewed as a 'magic moment' when both fathers and mothers may be highly motivated to work together to improve their relationship and co-parenting skills and deal with other problems that may limit their ability to support their children," according to the four scholars who wrote the introduction to a special issue of The Future of Children, a periodical funded by the Brookings Institution and the Woodrow Wilson School of Public and International Affairs at Princeton University.

Services to parents in such "fragile families" should be immediate, intense and focused on the couple in their role as cooperative parents, they wrote.

Supported by her hardworking single mom, Barbara, Jenelle doesn't fit the first study's definition of poor or disadvantaged. But Jenelle fulfills her billing on the show's website as a "beach bunny who loves partying."

As her due date approached, unfortunately, Jenelle's dream of a future with Andrew came undone. He denounced her in a phone call for going out with her girlfriends and called her "a piece of crap." Later he got himself thrown in jail on a DUI charge and informed Jenelle by calling her when he was already drunk again.

After the baby was born, Jenelle turned out to be less willing to do much of the work. Instead, she tossed the baby like a grenade into her 56-year-old mother's life. Things deteriorated from there.

Over her exhausted mother's protests, she often slipped away from the house and child care chores like an escaping convict.

"Imagine being in prison," she explains to friends in text-message-deep thoughts. Being the mother of a newborn "is like being in prison."

While you can't represent the complexity of teen pregnancy in a reality show like "16 & Pregnant" or MTV's "Teen Mom 2," which airs Tuesdays at 10 p.m., they are kind of *Juno*-lite, touching superficially on deeper truths about why teens get pregnant and what it means.

Some of what it means for the mothers is good.

Prior studies had never conclusively isolated the positive impact of early motherhood on delinquency, crime and drug use by teen girls in poor neighborhoods. Kreager and two co-authors, Ross L. Matsueda and Elena A. Erosheva, faculty members in the departments of sociology and statistics, respectively, at the University of Washington, set out to test the idea and dug into an existing database known as the Denver Youth Study. First presented at the annual meeting of the American Sociological Association in 2008, their paper appeared in the February 2010 issue of the journal *Criminology*.

Using data on 500 women gathered from 1988 to 1999, the three modeled various effects and isolated contributing causes. Kreager, Matsueda and Erosheva found that motherhood for women under 20 significantly reduced delinquency and marijuana and alcohol use.

Marriage, they determined, always had a smaller effect on delinquency and crime than pregnancy.

"That was striking," Kreager says. "In the general population, marriage for men is the way you settle down." But in the poor communities, which he studied, "marriage is unlikely and it's not stable and the person you're married to may be part of the problem."

Teen pregnancy is often viewed as a loss of control, but Kreager and his co-authors look at the problem of pregnant teens in the light of age-graded life course theory, which holds that modifications in individual behavior may occur through new experiences or social circumstances.

Other researchers had previously helped dissolve the public stereotype of teen pregnancy as a simple lack of discipline or control, showing that the girls saw motherhood as a rite of passage to adulthood and marriage as a prize in the distant future. One study found that having a child motivated the mother to stay in school and work hard for a career, with the hope of landing a good man with a job.

Picture a typical month for a poor girl in a city, where, although she may go to school, her life is a jumble of joblessness, food stamps, boredom and drugs. Older men around her tend to pressure her for sex; marriages and husbands, as far as she can see, come and go. She's more interested in relationships but pregnancy, she believes, is inevitable and likely to come early.

Seen in this light, bearing a child has less to do with a girl's lack of control than with the limited alternatives available. It also helps explain why so many teen moms are poor.

Scholars have zeroed in on other reasons girls want babies, such as the prestige, the chance to demonstrate love or commitment and the desire to replace someone they have lost or may lose.

There's another motive for some girls to have babies that I see: to strike a blow against their parents, who often are fearful that the work and expense will fall to them.

Near the end of the MTV episode, after several profanity-filled outbursts at her mother, Jenelle admits that raising a newborn "is a lot harder than I thought."

With Andrew largely out of the picture as a source of support, Jenelle saw herself going it alone with the baby — meaning, with a ton of help from Mom.

That provided a nice ending to the "16 & Pregnant" episode, but since the show, Jenelle has made other brief media appearances. There was the bonus coverage on MTV of her first date after Andrew. She also showed up in an Internet video smoking pot with a pal. Not very motherly.

When a teen girl decides to bear a child, of course, she limits her partying and libidinal playtime and invites respect as the creator and nurturer of a new life. That could be what a "bad" or rebellious teen craves — to fulfill an unconscious dream of goodness — and settle down one day, if not with the baby's father, then with another man.

I'd pay a little more on my taxes to keep that dream of family life alive with counseling for these clueless new parents, to give them a greater chance of sticking together through the burdens of night-feedings and diapers and rent.

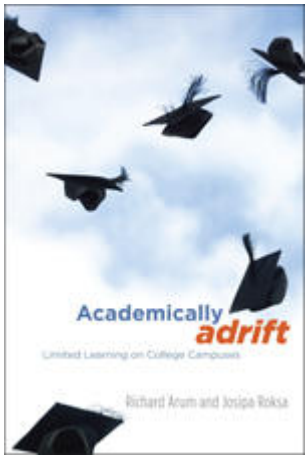
In a follow-up interview taped when Jenelle's baby was 7 months old, Jenelle and her mother sat together grimly facing MTV's camera. Neither expressed any holy hope or sacred idealism about the baby's future: Everything was about the mother-daughter struggle, and the work dumped on Barbara.

They're getting counseling, and Barbara has been made a legal guardian of her grandson, she and Jenelle explained, so that if Jenelle fulfills one of her frequent threats to run away, Barbara can make medical and educational decisions and Jenelle can't be charged with neglect.

Since we've reduced teen pregnancy with effective programs, I think we can afford to recognize that the problem has many dimensions, not all of which are destructive to the mother. Without endorsing teen child-bearing, we can see why poor girls and perhaps some living above the poverty line find salvation in motherhood. That there are complex motives behind these "accidents," where the mother may find focus, receive support, give and get love — and, just like a teenager, stick it to her parents.

http://www.miller-mccune.com/culture-society/the-upside-of-teen-pregnancy-26870/

'Academically Adrift'



Academically Adrift: Limited Learning on College Campuses, a book being released today by University of Chicago Press.

The book cites data from student surveys and transcript analysis to show that many college students have minimal classwork expectations -- and then it tracks the academic gains (or stagnation) of 2,300 students of traditional college age enrolled at a range of four-year colleges and universities. The students took the Collegiate Learning Assessment (which is designed to measure gains in critical thinking, analytic reasoning and other "higher level" skills taught at college) at various points before and during their college educations, and the results are not encouraging:

- 45 percent of students "did not demonstrate any significant improvement in learning" during the first two years of college.
- 36 percent of students "did not demonstrate any significant improvement in learning" over four years of college.
- Those students who do show improvements tend to show only modest improvements. Students improved on average only 0.18 standard deviations over the first two years of college and 0.47 over four years. What this means is that a student who entered college in the 50th percentile of students in his or her cohort would move up to the 68th percentile four years later -- but that's the 68th percentile of a new group of freshmen who haven't experienced any college learning.

"How much are students actually learning in contemporary higher education? The answer for many undergraduates, we have concluded, is not much," write the authors, Richard Arum, professor of sociology and education at New York University, and Josipa Roksa, assistant professor of sociology at the University of Virginia. For many undergraduates, they write, "drifting through college without a clear sense of purpose is readily apparent."

The main culprit for lack of academic progress of students, according to the authors, is a lack of rigor. They review data from student surveys to show, for example, that 32 percent of students each semester do not take any courses with more than 40 pages of reading assigned a week, and that half don't take a single course in which they must write more than 20 pages over the course of a semester. Further, the authors note that students spend, on average, only about 12-14 hours a week studying, and that much of this time is studying in groups.

The research then goes on to find a direct relationship between rigor and gains in learning:

- Students who study by themselves for more hours each week gain more knowledge -- while those who spend more time studying in peer groups see diminishing gains.
- Students whose classes reflect high expectations (more than 40 pages of reading a week and more than 20 pages of writing a semester) gained more than other students.
- Students who spend more time in fraternities and sororities show smaller gains than other students.
- Students who engage in off-campus or extracurricular activities (including clubs and volunteer opportunities) have no notable gains or losses in learning.
- Students majoring in liberal arts fields see "significantly higher gains in critical thinking, complex reasoning, and writing skills over time than students in other fields of study." Students majoring in business, education, social work and communications showed the smallest gains. (The authors note that this could be more a reflection of more-demanding reading and writing assignments, on average, in the liberal arts courses than of the substance of the material.)

In section after section of the book and the research report, the authors focus on pushing students to work harder and worrying less about students' non-academic experiences. "[E]ducational practices associated with academic rigor improved student performance, while collegiate experiences associated with social engagement did not," the authors write.

In an interview, Arum said that the problems outlined in the book should be viewed as a moral challenge to higher education. Students who struggle to pay for college and emerge into a tough job market have a right to know that they have learned something, he said. "You can't have a democratic society when the elite -- the college-educated kids -- don't have these abilities to think critically," he said.

The book rejects the idea of federal mandates on testing or the curriculum, suggesting that such requirements rarely work. And the book acknowledges that many college educators and students don't yet see a crisis, given that students can enroll, earn good grades for four years, and graduate -- very much enjoying themselves in the process. But in an era when "the world has become unforgiving" to those who don't work hard or know how to think, Arum said that this may be a time to consider real change.

The culture of college needs to evolve, particularly with regard to "perverse institutional incentives" that reward colleges for enrolling and retaining students rather than for educating them. "It's a problem when higher education is driven by a student client model and institutions are chasing after bodies," he said.

The analysis in the book stresses that there is significant variation within institutions, not just among institutions, with students in some academic programs regularly outperforming others at the same campuses. Arum said this suggests that institutions can improve student learning by making sure that there is some consistency across disciplines in the rigor of requirements. "You need an internal culture that values learning," he said. "You have to have departments agree that they aren't handing out easy grades."

Further, he said that colleges need to shift attention away from measures of "social engagement" (everything that's not academic) and toward academic engagement, even if some of those measures of non-academic engagement help keep students engaged and enrolled. "It's a question of what outcome you want," he said. "If the outcome is student retention and student satisfaction, then engagement is a great strategy. If, however, you want to improve learning and enhance the academic substance of what you are up to, it is not necessarily a good strategy."

(If this sounds like a swipe at the National Survey of Student Engagement, Arum said it shouldn't be taken that way. He praises NSSE for asking questions that focus on the student experience, and says that many of NSSE's findings on the minimalist levels of academic work and studying are consistent with his own. Rather,

he faults college administrators for paying little attention to those findings and more on NSSE measures of non-academic satisfaction.)

Arum acknowledged that the tough economy may be acting against reform, given that many professors report that increases in class size and course loads are leading them to cut down on the ambition of student assignments simply to keep up with grading. With fewer full-time positions, professors at many institutions "are overwhelmed," he said. But Arum challenged faculty members to be creative in finding ways to assign more writing and reading to students.

Distribution of the book is just starting, but there are signs it could generate buzz. The Social Science Research Council will host a panel this week in Washington featuring experts on assessment and higher education, with representatives from leading think tanks and foundations. The book will also be discussed at next week's meeting of the Association of American Colleges and Universities.

Debra Humphreys, vice president for communications and public affairs of AAC&U, said that she viewed the book as "devastating" in its critique of higher education. Faculty members and administrators (not to mention students and parents) should be alarmed by how little learning the authors found to be taking place, she said. Humphreys also said that the findings should give pause to those anxious to push students through and award more degrees -- without perhaps giving enough attention to what happens during a college education.

"In the race to completion, there is this assumption that a credit is a credit is a credit, and when you get to the magic number of credits, you will have learned what you need to learn," she said. What this book shows, Humphreys added, is that "you can accumulate an awful lot of credits and not learn anything."

AAC&U programs have in the past stressed the value of academic rigor and also of engagement of students outside the classroom. Humphreys said that she agreed with the book that some activities students enjoy may not add to their learning. But she said it was important not to view all engagement activities in the same way. It is important, she said, "not to lump together activities such as being in a fraternity or just hanging out with friends" with activities such as extracurricular activities that may in fact be quite educational and important, even if not linked to a specific course.

Students could benefit especially, she feels, from the point in the book about the variation among those at the same institution. "I don't think we are doing well enough at helping them understand that choices matter," she said. "Choices in the academic courses they take, how much they are working outside the classroom, how much they are studying, how much they are partying -- that balance is important."

— Scott Jaschik
http://www.insidehighered.com/news/2011/01/18/study_finds_large_numbers_of_college_students_don_t_learn_much

As Doctors Age, Worries About Their Ability Grow

By LAURIE TARKAN

About eight years ago, at the age of 78, a vascular surgeon in California operated on a woman who then developed a pulmonary embolism. The surgeon did not respond to urgent calls from the nurses, and the woman died.

Even after the hospital reported the doctor to the Medical Board of California, he continued to perform operations for four years until the board finally referred him for a competency assessment at the University of California, San Diego.

"We did a neuropsychological exam, and it was very abnormal," said Dr. William Norcross, director of the physician assessment program there, who did not identify the surgeon. "This surgeon had visual-spatial abnormalities, could not do fine motor movements, could not retain information, and his verbal I.Q. was much lower than you'd expect."

Yet "no one knew he had a cognitive deficit, and he did not think he had a problem," Dr. Norcross continued. The surgeon was asked to surrender his medical license.

One-third of the nation's physicians are over 65, and that proportion is expected to rise. As doctors in the baby boom generation reach 65, many are under increasing financial pressures that make them reluctant to retire.

Many doctors, of course, retain their skills and sharpness of mind into their 70s and beyond. But physicians are hardly immune to dementia, Parkinson's disease, stroke and other ills of aging. And some experts warn that there are too few safeguards to protect patients against those who should no longer be practicing. "My guess is that John Q. Public thinks there is some fail-safe mechanism to protect him from incompetent physicians," Dr. Norcross said. "There is not."

Often the mechanism does not kick in until a state medical board has found it necessary to discipline a physician. A 2005 study found that the rate of disciplinary action was 6.6 percent for doctors out of medical school 40 years, compared with 1.3 percent for those out only 10 years.

In 2006, a study found that in complicated operations, patients' mortality rates were higher when the surgeon was 60 or older, though there was no difference between younger and older doctors in routine operations.

Patient advocates note that commercial pilots, who are also responsible for the safety of others, must retire at age 65 and must undergo physical and mental exams every six months starting at 40. Yet "the profession of medicine has never really had an organized way to measure physician competency," said Diane Pinakiewicz, president of the nonprofit National Patient Safety Foundation. "We need to be systematically and comprehensively evaluating physicians on some sort of periodic basis."

Some experts are calling for regular cognitive and physical screening once doctors reach 65 or 70, and a small cadre of hospitals have instituted screening for older physicians. Some specialty boards already require physicians to renew their certification every 7 to 10 years and have toughened recertification requirements. But such policies have met resistance from rank-and-file doctors.

"I do not believe that diminished competence attributable solely to age is a significant factor in the underperformance of most poor-performing physicians," Dr. Henry Homburger, 64, professor of laboratory medicine at the Mayo Clinic, said by e-mail. Mental illness like depression, substance abuse and a "failure to

maintain competence through continuing education far outweigh age as causes of poor performance, in my opinion," he wrote.

Others doubt that a single type of exam can be used to assess the performance of doctors from a variety of specialties. "More research is needed for us to define what combination of cognitive and motor issues are important," said Dr. Stuart Green, a member of the ethics committee of the American Academy of Orthopaedic Surgeons.

Physicians do have to meet minimal requirements to continue to practice. To renew a medical license in most states, doctors must complete a certain number of hours of continuing medical education every year or two.

This does not impress experts like Dr. Norcross. "You can be asleep during those courses and no one would know," he said.

Even the tougher new policies of specialty boards do not usually apply to older physicians, who, because of "grandfather" clauses, are not required to renew their certification — an expensive, time-consuming process.

They are being encouraged to do so voluntarily, but few do — less than 1 percent of the 69,000 so-called grandfathered members of the American Board of Internal Medicine, for example.

Doctors with mild cognitive impairment may not be aware they have a problem or their performance is flagging. Changes are often subtle at first: a person may not be able to recall words, learn new material, apply knowledge to solving problems or multitask.

These deficits can make it hard to carry out the latest recommendations for diagnosis and treatment, learn new computer-based technology, remember prescribing details about medications, or function well in a stressful environment like the emergency room.

Only when a doctor's behavior starts to become odd are other physicians, nurses and patients likely to take notice.

Medical professionals are supposed to report colleagues' unsafe practices and bad behavior. But doctors are reluctant to confront their fellow physicians, especially their seniors, who may have trained them. "Sometimes we empathize too much and have difficulty making the hard calls when we need to," Dr. Norcross said.

Doctors often cover for physicians who are becoming less sharp, by having another surgeon in the operating room or by regularly reviewing their cases, Dr. Green said.

Dr. John Fromson, associate director of postgraduate medical education at Massachusetts General Hospital, cited a case at another medical center in New England, where physicians noticed cognitive changes in the 77-year-old chairman of internal medicine.

He was highly respected and had trained most of the physicians at the center, so they were reluctant to confront him. Instead, they gave him a retirement party, hoping he would take the hint. "But he didn't," Dr. Fromson said. "He kept on working."

Dr. Fromson staged an intervention, at which four or five of the doctor's close colleagues confronted him as compassionately as they could. "We reaffirmed our concern and caring for him, and asked him to hand over his medical license," he said. "He became quite tearful, but he did."

To lift this burden from peers while protecting patients, 5 percent to 10 percent of hospitals around the country have begun to address the issue of aging physicians more systematically, said Dr. Jonathan Burroughs, a consultant with the Greeley Company, which advises hospitals and health care companies.

"The other 90 to 95 percent are not willing to take this on," he said. In some instances, their efforts have been squashed by a vocal medical staff.

At Driscoll Children's Hospital in Corpus Christi, Tex., Dr. Karl Serrao, the credentials chairman, decided to move slowly and enlisted the staff's help in drafting a policy for aging physicians. The staff expressed concerns about age discrimination, losing the valuable experience of older physicians and invasion of privacy. Now the hospital's policy states that when doctors 70 and older are up for reappointment, they must undergo cognitive and physical exams that assess skills specific to their specialty.

Dr. Burroughs says that screening physicians may be a more compassionate route than doctors think. "By identifying the issue early enough, it enhances their chance of being able to practice longer," he said. When a cognitive deficit is discussed openly, the physician's practice can be simplified, he can reduce his patient load, and his partners can regularly monitor and assess his work.

"But once something bad happens," Dr. Burroughs said, "he'll get his license taken away."

http://www.nytimes.com/2011/01/25/health/25doctors.html?_r=1&nl=health&emc=healthupdateema2

F.D.A and Dairy Industry Spar Over Testing of Milk

By WILLIAM NEUMAN

Each year, federal inspectors find illegal levels of antibiotics in hundreds of older dairy cows bound for the slaughterhouse. Concerned that those antibiotics might also be contaminating the milk Americans drink, the Food and Drug Administration intended to begin tests this month on the milk from farms that had repeatedly sold cows tainted by drug residue.

But the testing plan met with fierce protest from the dairy industry, which said that it could force farmers to needlessly dump millions of gallons of milk while they waited for test results. Industry officials and state regulators said the testing program was poorly conceived and could lead to costly recalls that could be avoided with a better plan for testing.

In response, the F.D.A. postponed the testing, and now the two sides are sparring over how much danger the antibiotics pose and the best way to ensure that the drugs do not end up in the milk supply.

"What has been served up, up to this point, by Food and Drug has been potentially very damaging to innocent dairy farmers," said John J. Wilson, a senior vice president for Dairy Farmers of America, the nation's largest dairy cooperative. He said that that the nation's milk was safe and that there was little reason to think that the slaughterhouse findings would be replicated in tests of the milk supply.

But food safety advocates said that the F.D.A.'s preliminary findings raised issues about the possible overuse of antibiotics in livestock, which many fear could undermine the effectiveness of drugs to combat human illnesses.

"Consumers certainly don't want to be taking small amounts of drugs every time they drink milk," said Caroline Smith DeWaal, food safety director of the Center for Science in the Public Interest, an advocacy group. "They want products that are appropriately managed to ensure those drug residues aren't there, and the dairy farmer is the one who can control that."

The F.D.A. said that it would confer with the industry before deciding how to proceed. “The agency remains committed to gathering the information necessary to address its concern with respect to this important potential public health issue,” it said in a statement.

The concerns of federal regulators stem from tests done by the Department of Agriculture on dairy cows sent to be slaughtered at meat plants. For years, those tests have found a small but persistent number of animals with drug residues, mostly antibiotics, that violate legal limits.

The tests found 788 dairy cows with residue violations in 2008, the most recent year for which data was available. That was a tiny fraction of the 2.6 million dairy cows slaughtered that year, but regulators say the violations are warning signs because the problem persists from year to year and some of the drugs detected are not approved for use in dairy cows.

The question for the F.D.A. is whether cows that are producing milk also have improper levels of such drugs in their bodies and whether traces of those drugs are getting into the milk.

Regulators and veterinarians say that high levels of drugs can persist in an animal’s system because of misuse of medicines on the farm.

That can include exceeding the prescribed dose or injecting a drug into muscle instead of a vein. Problems can also occur if farmers do not follow rules that require them to wait for a specified number of days after administering medication before sending an animal to slaughter or putting it into milk production.

“F.D.A. is concerned that the same poor management practices which led to the meat residues may also result in drug residues in milk,” the agency said in a document explaining its plan to the industry. In the same document, the F.D.A. said it believed that the nation’s milk supply was safe.

Today, every truckload of milk is tested for four to six antibiotics that are commonly used on dairy farms. The list includes drugs like penicillin and ampicillin, which are also prescribed for people. Each year, only a small number of truckloads are found to be “hot milk,” containing trace amounts of antibiotics. In those cases, the milk is destroyed.

But dairy farmers use many more drugs that are not regularly tested for in milk. Regulators are concerned because some of those other drugs have been showing up in the slaughterhouse testing.

Federal officials have discussed expanded testing for years. But industry executives said that it was not until last month that the F.D.A. told them it was finally going to begin.

The agency said that it planned to test milk from about 900 dairy farms that had repeatedly been caught sending cows to slaughter with illegal levels of drugs in their systems.

It said it would test for about two dozen antibiotics beyond the six that are typically tested for. The testing would also look for a painkiller and anti-inflammatory drug popular on dairy farms, called flunixin, which often shows up in the slaughterhouse testing.

The problem, from the industry’s point of view, is the lengthy time it takes for test results.

The tests currently done for antibiotics in milk take just minutes to complete. But the new tests could take a week or more to determine if the drugs were present in the milk.

Milk moves quickly onto store shelves or to factories where it is made into cheese or other products. The industry worried that, under the F.D.A. plan, by the time a load of milk was found to be contaminated, it could already be in consumers' refrigerators, and that could lead to recalls.

One Northeast cooperative, Agri-Mark, sent a letter to its members last month instructing them to dump milk if it had been tested by the F.D.A. "Agri-Mark must ensure that all of our milk sales, cheese, butter and other products are in no danger of recall," the letter said.

Other industry executives said that processing plants would refuse to take any milk from a farm that had been tested until the results showed it was drug-free, meaning farmers could end up dumping milk for a week or more while waiting.

The F.D.A. plan was also criticized by state officials that regulate the dairy industry.

In a sharply worded Dec. 29 letter, the top agriculture officials of 10 Northeastern states, including New York and Pennsylvania, which are both leading dairy producers, told the F.D.A. that its plan was badly flawed. Among other problems, the letter said, forcing farmers to dump large quantities of milk could create environmental problems.

The F.D.A. said it would consider the regulators' comments as it reviewed its testing plan.

http://www.nytimes.com/2011/01/26/business/26milk.html?ref=health

A Provocateur Who Talks to Strangers

By JEFFREY KASTNER

Courtesy of Leslie Tonkonow Artworks & Projects

An image from Laurel Nakadate's "Exorcism

"IT'S a little like sneaking around your old school," Laurel Nakadate said, flashing a conspiratorial grin as she led a visitor up a staircase to the second floor of the repurposed school building that houses MoMA P.S. 1 in Long Island City, Queens. Closed and quiet on a mid-December day, that exhibition complex would soon display Ms. Nakadate's first major museum show — "Only the Lonely," opening Sunday — and she had just moved into a temporary studio there, across the hall from the galleries where the 10-year survey of her film, video and photography projects would be installed.

Trespassing, or at least pretending to, is nothing new for Ms. Nakadate. Her work often finds her doing things she probably shouldn't, in places she probably should not be: strange men's apartments, for example, hosting pretend birthday parties or posing for sketches in her underwear (and less) or acting out exorcisms; or at young womens' bedsides, an unseen intruder attempting to coax them out of their sleepwear with a string of honeyed platitudes. Repeatedly testing the limits of sexual candor, gender dynamics and the lines between performance and real life — often all at once — Ms. Nakadate's art pushes a mailbag's worth of envelopes. But such pieces are not inspired, she said, simply by a desire to shock.

"I think it's easy to misunderstand work that deals with someone going out into the world and trying to make sense of situations that they may or may not belong in," Ms. Nakadate, 35, said as she pulled up a chair in her

work space. “For me one of the primary motivations at the beginning of this work was going out into the world and meeting strangers. And whether I was meant to be part of their world or not, I just wanted to spend some time there.”

The urge to insinuate herself into other people’s lives was evident in her earliest artworks. Ms. Nakadate (pronounced nah-ka-da-TAY) grew up in Ames, Iowa, and moved to Boston in the mid-1990s to attend a program sponsored by Tufts University and the School of the Museum of Fine Arts. A friend at Wellesley College introduced her to the social rituals at that women-only school, especially the legendary parties featuring young men from Harvard and M.I.T. who would arrive at the campus on a weekend shuttle bus.

“It was this moment in the girls’ sort of postfeminist movement where their way of empowering themselves was having these enormous parties where they didn’t apologize for anything,” said Ms. Nakadate, who was fascinated by peers “so unafraid of failure,” and seemingly unconcerned with “trying to please people, or trying to put on the correct veneer.” She spent the next four years shadowing students at Wellesley and other nearby women’s colleges, interviewing them and documenting their lives in photographs.

“It taught me a lot about what it means to make pictures,” she said. “And it taught me to be brave and go and talk to people you wouldn’t normally talk to and work your way into situations so that you can make the photograph.”

After graduation in 1998 Ms. Nakadate immediately began to pursue her M.F.A. at Yale and found herself in an unfamiliar city and a program that strongly encouraged risk taking. One day a man began chatting her up in the parking lot of a home-improvement store.

“He gave me his number, and he was like, ‘Give me a call, but if my mom picks up, just tell her you met me at Home Depot.’ I said, ‘Well, I have a boyfriend, but I’m an art student, and maybe we could make a video together or something.’ ” Ms. Nakadate’s spontaneous decision to suggest making an artwork with him would completely alter the course of her projects.

“It was just one of those moments where I had no idea what I was saying,” she remembered. “I really wanted to push myself. And I think I was in this place where I was so afraid to fail that I thought, ‘Well, I just have to take fear out of this. Fear’s not an element, and I don’t have to follow any social codes, so what can happen? Anything can happen.’ ”

Although Ms. Nakadate didn’t end up making work with that first man, she said the experience taught her that she could have. Over the next decade she would create dozens of photography and video projects in which she play-acted in scenes with strangers: typically single, middle-aged and seemingly socially awkward men she met during her everyday life.

The scenarios range from the goofy (Ms. Nakadate and her co-stars on all fours, pretending to be dogs and cats) to the disturbing (a series of men screaming invectives at absent former lovers). All have an obvious edge of sexual tension, often quite consciously cultivated by Ms. Nakadate, and a persistent sense of unease.

Yet she also manages to imbue her work with a finely calibrated sense of respect and tenderness, transforming what can seem perilously close to exploitation in some instances into a poignant meditation on a certain kind of loneliness, and the longing that accompanies it. The exchanges ultimately end up seeming somehow therapeutic, not only for the men but also perhaps for Ms. Nakadate, who said she has been intrigued by marginal characters since, as a child, she noticed a roadside tent on a trip to summer camp that her father said was inhabited by “a hermit” — a person who lived, much to the young Ms. Nakadate’s surprise and confusion, isolated from friends and family.

Although it she is probably best known for her video work with men, Ms. Nakadate has also made solo pieces throughout her career: oblique, MTV-style videos that feature her dancing in the desert or before a sky full of fireworks; documents of her flashing her breasts to no one in particular from the window of a speeding passenger train; and, in one extraordinary piece that she was reluctant to show for several years after its creation, a sequence of herself on the roof of her apartment building in a Girl Scout uniform on the morning of 9/11, blinking back tears and saluting as smoke billows in the sky behind her.

She has continued using photography, as well; the P.S. 1 survey will feature a new series titled "365 Days: A Catalogue of Tears," documenting a year of daily sobs (real and performed) that would seem to nod equally to diaristic reality-TV histrionics and the temporal experiments of On Kawara or Tehching Hsieh. The exhibition — organized by P.S. 1's director, Klaus Biesenbach — also features her most recent, and elaborate, projects: a pair of feature-length films.

Both of these — "Stay the Same Never Change" (which had its premiere at Sundance in 2009) and "The Wolf Knife" (which earned Ms. Nakadate nominations for a 2010 Gotham Independent Film Award and an 2011 Independent Spirit Award) — mostly avoid the claustrophobic mania of the video pieces, and they echo some of Ms. Nakadate's first fascinations, particularly the dynamics of young women's external relationships and inner lives. "Stay the Same" — made on a shoestring with an amateur cast around Kansas City, Mo. — is essentially a series of beautifully shot video-length vignettes sutured into a full-length film. "The Wolf Knife" offers a fuller narrative arc, tracing the relationship between a pair of teenage girls who embark on a misbegotten road trip.

Although she said she will continue making other kinds of work, Ms. Nakadate is clearly excited by the particular challenges and rewards of filmmaking.

"People who love movies love looking at the world," she said. "Whether they love looking at the world through the processed lens of a director or whether they love looking at the world in the real world, I'm not really sure. But anybody who likes to look is someone I'm interested in spending time with."

http://www.nytimes.com/2011/01/23/arts/design/23nakadate.html

Late Style

By BROOKE ALLEN

LASTINGNESS

The Art of Old Age

By Nicholas Delbanco

Illustrated. 261 pp. Grand Central Publishing. $24.99.

The question of "old-age art" is mysterious and perennially fascinating. Creative artists who continue to work late in life so often seem to undergo a sea change: a distillation, a new intensity, a sloughing off of excess and ornament in favor of deep essentials. W. B. Yeats, himself a notable example of the phenomenon, provided an image for it: "Though leaves are many, the root is one; / Through all the lying days of my youth / I swayed my leaves and flowers in the sun; / Now I may wither into the truth."

Having published his first novel back in 1966, Nicholas Delbanco admits to taking a personal interest in this aging process. His new book, "Lastingness: The Art of Old Age," touches on the late works of a number of great elders, including such geriatric wonders as Matisse, Monet, Sophocles, Sibelius, Picasso, Thomas Hardy and Ralph Vaughan Williams. Why do some artists (Delbanco mentions Saul Bellow, James Baldwin and Norman Mailer) mature early and then run out of steam, producing only second-rank work in their last decades, while others gain momentum and occasionally even peak in old age? What, if anything, do the many examples of great old-age art have in common?

Delbanco raises a number of such questions but fails to answer most of them, skipping restlessly over the surface of his subject. He mentions that Hardy quit writing novels at 55 and embarked, only then, on his career as a superlative poet, but he doesn't tell us what differentiates the spirit and style of this old-age poetry from the novels of Hardy's youth. He relates all the well-known events of Franz Joseph Haydn's long career but never bothers to analyze the progress of his output — nor does he even mention the interesting fact that

Haydn was one of the very few major artists (John Updike was another) who never seemed to develop a "late style" in old age.

Delbanco treats his material in anecdotal fashion and draws few conclusions from his research, though clearly some generalizations can and must be made. Look at Michelangelo's half-finished "Slaves," apparently struggling to escape their blocks of marble; Titian's "Death of Actaeon"; Verdi's "Otello"; Liszt's "Czardas Macabre"; Francis Bacon's minimalist late works. All these suggest that the aesthetic of old age involves a slimming down and stripping away. Delbanco does remark on this syndrome in individual cases: he is surely correct to emphasize, for instance, Monet's "Nymphéas" and the other late-period Giverny works, in which, "if his vision now was less than 20-20, what he trained himself to paint had an inward-facing coherence that outstripped mere accuracy." He discusses the same qualities in "The Winter's Tale" (though Shakespeare, dead at 52, was not quite old even by 17th-century standards): "The late plays," Delbanco observes, "are less sequence-bound or yoked to plausibility. It's as though the peerless artificer has had enough of artifice."

This is true, and Delbanco offers one intriguing explanation. In youth, he posits, "it's the reception of the piece and not its production that counts. But to the aging writer, painter or musician the process can signify more than result; it no longer seems as important that the work be sold." It is a profound observation; with time and age, the act of showing becomes increasingly subordinate to the act of making, and gratification turns ever further inward. But this is surely not the only reason for the concentrated effect of late style. The simple specter of mortality must count for something: as Samuel Johnson remarked in a different context, "When a man knows he is to be hanged in a fortnight, it concentrates his mind wonderfully." And then there is the radical shifting of perspective and values brought about by age, something to which people past their 50th birthdays can attest. Delbanco quotes Carl Jung: "We cannot live the afternoon of life according to the program of life's morning; for what was great in the morning will be little at evening, and what in the morning was true will at evening have become a lie."

There is clearly a major book waiting to be written on old-age art, but "Lastingness," more *amuse-bouche* than meaty repast, is not the one. Neither was Edward Said's "On Late Style" (2006), being merely a collection of notes Said had made on the subject, presumably with a future book in mind, before his death in 2003. Academic studies by Kenneth Muir, Michael Millgate and, most recently, Philip Sohm are more thorough, but each of these authors has voluntarily limited the scope of his study. Oddly enough, there have been essays on the question — notably "The Artist Grows Old," by Kenneth Clark, and Rudolf Arnheim's "On the Late Style" — that have offered more intellectual nourishment than Delbanco's book does.

Perhaps one reason Delbanco fails to penetrate too deeply into the work of any of his elderly subjects is that he seems, in the end, more interested in his own late style than in theirs. He is a self-referential author, too apt to quote from his own works and fatally addicted to fine writing. Readers who find themselves irritated by phrases like "an unyielding fealty to the yield of work" will not take kindly to Delbanco's prose. His habit of dropping preciosities like "soon or late" and "dear reader" and of beginning sentences with "Too, . . ." would have made me fling the book down if I hadn't found its subject matter so extremely absorbing.

But of course it *is* absorbing. If "Lastingness" serves no other purpose than to raise a few of these questions in the general reader's mind, it will prove to have been a worthwhile exercise.

Brooke Allen's new book, "The Other Side of the Mirror: An American Travels in Syria," will be published in March.

http://www.nytimes.com/2011/01/23/books/review/Allen-t.html?ref=design

Tales of Lives Richly Lived, but True?

By EDWARD ROTHSTEIN

Graham Haber

Sophia Peabody Hawthorne's journal is included in "The Diary" with the diary of her husband, Nathaniel Hawthorne

"I have tried to keep diaries before," John Steinbeck writes in a giant ledger book filled with his methodical script, "but they didn't work out because of the necessity to be honest."

This particular journal, on display at the Morgan Library & Museum in a compelling exhibition that opened on Friday, "The Diary: Three Centuries of Private Lives," has such a modest goal — chronicling Steinbeck's work on "The Grapes of Wrath" — that it probably does not bend the truth too much. But spend some time with these diaries, intelligently culled from the Morgan's archives by Christine Nelson, the museum's curator of literary and historical manuscripts, and you see how fervently the keepers of journals labor to shape accounts of themselves.

These diaries span more than the three centuries of the exhibition's subtitle. They are the chronicles of the famous (Nathaniel Hawthorne) and obscure (Adèle Hugo, Victor's daughter); royalty (Queen Victoria recounting her journeys in the Highlands) and pirates (Bartholomew Sharpe, who preyed on the Spanish in the 17th century); and child writers (J. P. Morgan as a 9-year-old) and writers for children (E. B. White, who used his own diaries as a sometime source). Bob Dylan's 1973-74 travel journal of his tour with the Band is opened to his sketch of a view from a Memphis hotel room; Einstein's 1922 travel diary is open to calculations related to electromagnetism and general relativity, written on the page's flip side.

The variety is dizzying. The diaries are written in bound volumes (like Sir Walter Scott's) or relegated to a scratch pad (like an account of the 9/11 attacks by Steven Mona, a New York City police lieutenant). They are energetically scribbled (like Henry David Thoreau's, written with pencils made by his family's own company — a packet is on display) or crazily compressed into nearly microscopic print (like the fantastical reaction to a dark and stormy night by a young Charlotte Brontë). All of these are astonishing presentations, confessions, performances — often self-conscious and, perhaps, occasionally honest.

Our own era, of course, has turned spontaneous journalizing into something of a fetish, as 140-character tweets supposedly spring spontaneously from the thumbs of celebrities; scores of electronic walls sprout on which "friends" post tirelessly about their socially networked activities; and blogs are tossed into the electronic ether like rolled-up notes floating in virtual bottles. And though far less distinguished, the contemporary mix of self-invention, self-promotion and self-revelation is probably not that different from what is on display here.

The pioneers of the well-shaped self are represented by the first printed edition of St. Augustine's "Confessions," from the 15th century, and by the first printed edition of that book's 18th-century secular heir, Rousseau's "Confessions" — narratives that are meticulously shaped to make certain points and stake certain claims. More valuable for straightforward reportage is Samuel Pepys' 17th-century account of the Great Fire of London, seen here in the corrected proofs of the first edition of his diaries, along with a single sheet showing the shorthand that he used to encode 3,000 handwritten pages; they were deciphered only after more than a century.

But how are personal secrets, shames and private sensations treated in these works? Some incorporate secret writing: hieroglyphs in one, mirror writing in another. Adèle Hugo expresses her passionate love using scrambled words in a diary that inspired Truffaut's film "The Story of Adèle H.," which will be screened at the Morgan in April in conjunction with this exhibition.

Sometimes the diaries simply avoid anything explicitly self-revelatory. The overwritten, aphoristic first volume of Thoreau's journals from 1837 may reflect not just his youth (he was born in 1817), but also his avoidance of the personal, with plush Romantic-era language (describing, for example, the shore's changing scenery as "far reaching and sublime, but ever calm and gently undulating").

And we probably should accept White's judgment of his own early journals, which in a transcript of his 1969 interview with The Paris Review, he says are stored in "two-thirds of a whisky carton."

"They are," he says, "callow, sententious, moralistic, and full of rubbish."

But other diarists edit their supposedly spontaneous texts, excising undesirable allusions, cultivating a desired image. A typescript of a volume of Anaïs Nin's diary, which the author describes as the "uncut version," is far from it, Ms. Nelson points out: "Nin — like all diarists —crafted the story of her life, choosing the identity she wished to present to her friends, the public and herself." And a journal that was jointly kept by Hawthorne and his wife, Sophia, is shown with passages blacked out by Sophia to keep them from posterity's glance.

Nevertheless, many diaries on display are almost painful in their confrontations with the recalcitrant reality of their authors' lives and characters. An enormous volume by the British slaveholder John Newton recounts his spiritual conversion (which led to the composition of the hymn "Amazing Grace" and to his later opposition to slavery), but also his "repeated backslidings": "I have been reading what I have recorded of my experience in the last year — a strange vanity. I find myself condemnd in every page."

And a bit playfully, a volume of John Ruskin's diaries from 1878 shows the heading "February to April, the Dream" above blank pages. They are a deliberate gap this critic left to mark the period of his mental

breakdown — a nightmare. Later Ruskin went back over the early parts of his diary, trying to discern his latent symptoms.

Unexpectedly touching is a hastily written series of entries by Tennessee Williams from the 1950s; he was being hailed for his genius even as he languished in loneliness and anxiety, dependent on drugs and alcohol.

"A black day to begin a blue journal," he writes at the opening of the notebook on display; then an evening's sexual encounters suggest that a "benign Providence" had "suddenly taken cognizance and pity of my long misery this summer and given me this night as a token of forgiveness."

Throughout the show, examples of powerful emotions and experience erupt from staid pages. There are also some extraordinary historical documents, including a leather portfolio and diary carried by Napoleon's surgeon in chief, Dominique Jean Larrey, through the disastrous French campaign in Russia in 1812-13. Napoleon said Larrey was "the finest man I've known," and Tolstoy has him assessing Prince Andrew's critical injuries in "War and Peace."

Here Larrey recounts the horrors of battle, describing mothers drowning themselves while embracing their children amid 30,000 dead: "A greater disaster than this has never been seen."

The diligent visitor will take advantage of the exhibition's booklet of transcriptions of some of the more cryptic entries, as well as of the tender, insightful audio guide prepared by Ms. Nelson. Over all, more about the sociology of diaries and the fashion for sharing them could perhaps have been explored. And there are things I wish it were possible to see more of, including sections of Sir Walter Scott's journal that show his gradual loss of language after a series of strokes.

"I am not the man that I was," he writes. "The plough is coming to the end of the furrow."

But the exhibition is so rich that it dissatisfies only by being limited. And it has one object that few can have ever seen: a rare pocket-size calendar from 1609 with blank pages treated with coatings of gesso and glue. Using a stylus (no ink required), the owner could keep a diary without worrying about either honesty or secrecy. Instructions are given for treatment after writing: "Take a little peece of Spunge, or a Linnencloath, being cleane without any soyle: wet it in water" and "wipe that you have written very lightly, and it will out, and within one quarter of a hower you may write in the same place againe." It is the first erasable diary, a Renaissance iPad.

"The Diary: Three Centuries of Private Lives" runs through May 22 at the Morgan Library & Museum, 225 Madison Avenue, at 36th Street; (212) 685-0008, themorgan.org.

http://www.nytimes.com/2011/01/22/arts/design/22diary.html?ref=design

Nonfiction: Nabokov Theory on Butterfly Evolution Is Vindicated

By CARL ZIMMER

Roger Vila

A male Acmon blue butterfly (Icaricia acmon). Vladimir Nabokov described the Icaricia genus in 1944

Vladimir Nabokov may be known to most people as the author of classic novels like "Lolita" and "Pale Fire." But even as he was writing those books, Nabokov had a parallel existence as a self-taught expert on butterflies.

He was the curator of lepidoptera at the Museum of Comparative Zoology at Harvard University, and collected the insects across the United States. He published detailed descriptions of hundreds of species. And in a speculative moment in 1945, he came up with a sweeping hypothesis for the evolution of the butterflies he studied, a group known as the Polyommatus blues. He envisioned them coming to the New World from Asia over millions of years in a series of waves.

Few professional lepidopterists took these ideas seriously during Nabokov's lifetime. But in the years since his death in 1977, his scientific reputation has grown. And over the past 10 years, a team of scientists has been applying gene-sequencing technology to his hypothesis about how Polyommatus blues evolved. On Tuesday in the Proceedings of the Royal Society of London, they reported that Nabokov was absolutely right.

"It's really quite a marvel," said Naomi Pierce of Harvard, a co-author of the paper.

Nabokov inherited his passion for butterflies from his parents. When his father was imprisoned by the Russian authorities for his political activities, the 8-year-old Vladimir brought a butterfly to his cell as a gift. As a teenager, Nabokov went on butterfly-hunting expeditions and carefully described the specimens he caught,

imitating the scientific journals he read in his spare time. Had it not been for the Russian Revolution, which forced his family into exile in 1919, Nabokov said that he might have become a full-time lepidopterist.

In his European exile, Nabokov visited butterfly collections in museums. He used the proceeds of his second novel, "King, Queen, Knave," to finance an expedition to the Pyrenees, where he and his wife, Vera, netted over a hundred species. The rise of the Nazis drove Nabokov into exile once more in 1940, this time to the United States. It was there that Nabokov found his greatest fame as a novelist. It was also there that he delved deepest into the science of butterflies.

Nabokov spent much of the 1940s dissecting a confusing group of species called Polyommatus blues. He developed forward-thinking ways to classify the butterflies based on differences in their genitalia. He argued that what were thought to be closely related species were actually only distantly related.

At the end of a 1945 paper on the group, he mused on how they had evolved. He speculated that they originated in Asia, moved over the Bering Strait, and moved south all the way to Chile.

Allowing himself a few literary flourishes, Nabokov invited his readers to imagine "a modern taxonomist straddling a Wellsian time machine." Going back millions of years, he would end up at a time when only Asian forms of the butterflies existed. Then, moving forward again, the taxonomist would see five waves of butterflies arriving in the New World.

Nabokov conceded that the thought of butterflies making a trip from Siberia to Alaska and then all the way down into South America might sound far-fetched. But it made more sense to him than an unknown land bridge spanning the Pacific. "I find it easier to give a friendly little push to some of the forms and hang my distributional horseshoes on the nail of Nome rather than postulate transoceanic land-bridges in other parts of the world," he wrote.

When "Lolita" made Nabokov a star in 1958, journalists were delighted to discover his hidden life as a butterfly expert. A famous photograph of Nabokov that appeared in The Saturday Evening Post when he was 66 is from a butterfly's perspective. The looming Russian author swings a net with rapt concentration. But despite the fact that he was the best-known butterfly expert of his day and a Harvard museum curator, other lepidopterists considered Nabokov a dutiful but undistinguished researcher. He could describe details well, they granted, but did not produce scientifically important ideas.

Only in the 1990s did a team of scientists systematically review his work and recognize the strength of his classifications. Dr. Pierce, who became a Harvard biology professor and curator of lepidoptera in 1990, began looking closely at Nabokov's work while preparing an exhibit to celebrate his 100th birthday in 1999. She was captivated by his idea of butterflies coming from Asia. "It was an amazing, bold hypothesis," she said. "And I thought, 'Oh, my God, we could test this.' "

To do so, she would need to reconstruct the evolutionary tree of blues, and estimate when the branches split. It would have been impossible for Nabokov to do such a study on the anatomy of butterflies alone. Dr. Pierce would need their DNA, which could provide more detail about their evolutionary history.

Working with American and European lepidopterists, Dr. Pierce organized four separate expeditions into the Andes in search of blues. Back at her lab at Harvard, she and her colleagues sequenced the genes of the butterflies and used a computer to calculate the most likely relationships between them. They also compared the number of mutations each species had acquired to determine how long ago they had diverged from one another.

There were several plausible hypotheses for how the butterflies might have evolved. They might have evolved in the Amazon, with the rising Andes fragmenting their populations. If that were true, the species would be closely related to one another.

But that is not what Dr. Pierce found. Instead, she and her colleagues found that the New World species shared a common ancestor that lived about 10 million years ago. But many New World species were more closely related to Old World butterflies than to their neighbors. Dr. Pierce and her colleagues concluded that five waves of butterflies came from Asia to the New World — just as Nabokov had speculated.

“By God, he got every one right,” Dr. Pierce said. “I couldn’t get over it — I was blown away.”

Dr. Pierce and her colleagues also investigated Nabokov’s idea that the butterflies had come over the Bering Strait. The land surrounding the strait was relatively warm 10 million years ago, and has been chilling steadily ever since. Dr. Pierce and her colleagues found that the first lineage of Polyommatus blues that made the journey could survive a temperature range that matched the Bering climate of 10 million years ago. The lineages that came later are more cold-hardy, each with a temperature range matching the falling temperatures.

Nabokov’s taxonomic horseshoes turn out to belong in Nome after all.

"What a great paper," said James Mallet, an expert on butterfly evolution at University College London. "It's a fitting tribute to the great man to see that the most modern methods that technology can deliver now largely support his systematic arrangement."

Dr. Pierce says she believes Nabokov would have been greatly pleased to be so vindicated, and points to one of his most famous poems, “On Discovering a Butterfly.” The 1943 poem begins:

I found it and I named it, being versed

in taxonomic Latin; thus became

godfather to an insect and its first

describer — and I want no other fame.

“He felt that his scientific work was standing for all time, and that he was just a player in a much bigger enterprise,” said Dr. Pierce. “He was not known as a scientist, but this certainly indicates to me that he knew what it’s all about.”

This article has been revised to reflect the following correction:

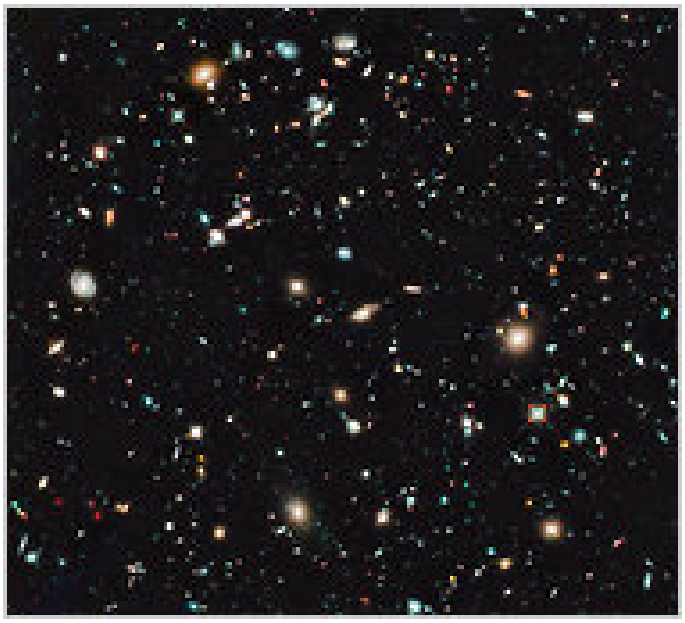
Correction: January 26, 2011

An earlier version of this article misstated the year Vladimir Nabokov immigrated to the United States. It was 1940, not 1941.

http://www.nytimes.com/2011/02/01/science/01butterfly.html?ref=science

In Hubble's Lens, Signs of Old and Distant Galaxy

By DENNIS OVERBYE



NASA

A photo from the Hubble Space Telescope that is the deepest image of the sky ever obtained in the near-infrared.

Leapfrogging into the past with the refurbished Hubble Space Telescope, a team of astronomers say they have detected what may be the most distant and earliest galaxy yet found. It is a smudge of light only a tiny fraction of the size of our own Milky Way galaxy, and it existed when the universe was only 480 million years old. Its light has been on its way to us for 13.2 billion years, making it the long-distance champ in an expanding universe.

If confirmed, the discovery takes astronomers deep into an era when stars and galaxies were first lighting up the universe and burning their way out of a primordial fog known as the dark ages. The birth rate of stars, they concluded from their observations, increased tenfold in the 200 million years between the time of the newly discovered galaxy and the next earliest known galaxies, which date to 650 million years after the Big Bang — a rate even faster than astronomers had thought.

"This is clearly an era when galaxies were evolving rapidly," the astronomers said in an article published on Wednesday in the journal Nature. The team was led by Rychard J. Bouwens of the University of California, Santa Cruz, and Leiden Observatory in the Netherlands, and Garth Illingworth of the University of California, Santa Cruz.

Shortly after the Hubble was refurbished in 2009, Dr. Bouwens and his colleagues observed a patch of sky known as the Hubble Ultra Deep Field in the constellation Fornax with the telescope's new Wide Field Camera 3, which is sensitive to the long-wave "heat" radiation known as infrared. That is important because as galaxies fly away from us in the expanding universe, the light they emit is shifted to longer wavelengths — "red-shifted," in cosmological parlance — the way a receding siren sounds lower.

That data yielded a crop of galaxies dating from 600 million to 800 million years after the Big Bang and a hint of an even earlier galaxy, in which visible light appears to have been shifted all the way into the infrared by a factor of 10, corresponding to a time of only 480 million years after the universe began. After a year of testing and simulations, the team concluded that it was the most primordial galaxy yet found. Spectroscopic observations with the forthcoming James Webb Space Telescope, however, are needed to cement the identification of the smudge as a galaxy.

Meanwhile, the new result fits in well with a picture cosmologists have developed from a variety of sources. In it, the first stars formed around 200 million or 300 million years after the Big Bang, and then the universe continued building more and more stars, reaching a peak of fecundity when it was about two and a half billion years old. Its glory days behind it, the cosmos is now in a middle-age slump.

They leave unclear, however, a longstanding mystery as to how the universe became transparent. As the initial fires of the Big Bang cooled, cosmologists say, the universe was enveloped in a pea-soup fog of hydrogen gas. Over the next billion years, that fog lifted as the hydrogen atoms were stripped of their electrons — ionized — by high-energy radiation, presumably from the early stars, and became transparent. The problem is that astronomers disagree on whether they have been able to find enough stars or galaxies in the very early universe yet to account for the amount of light it would have taken to burn off all the fog.

As a result, some astronomers have suggested that massive black holes could have been partly or mostly responsible for clearing the dark ages, as they are known. The black holes would have whipped the space around them with high-energy particles and radiation shed by matter in its death throes.

Dr. Bouwens said it was not quite time to resort to black holes as the explanation, however; he noted that many more galaxies could be lurking in the noise just below the limits of detection for the Hubble.

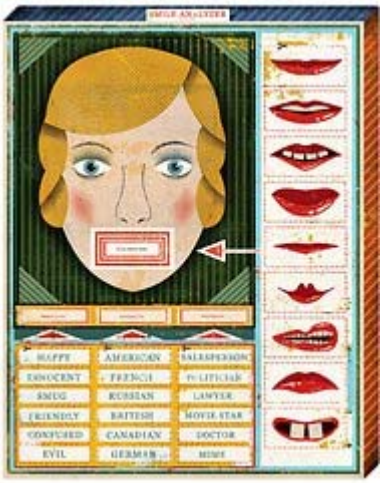
“We really are not probing faint enough with the current Hubble observations to see beyond the tip of the iceberg,” Dr. Bouwens said.

The Webb telescope, which is expected to be launched later this decade once NASA figures out how to pay for it, has been designed to find these primordial galaxies and thus illuminate the dark ages.

http://www.nytimes.com/2011/01/27/science/space/27galaxy.html?ref=science

More to a Smile Than Lips and Teeth

By CARL ZIMMER



In the middle of a phone call four years ago, Paula Niedenthal began to wonder what it really means to smile. The call came from a Russian reporter, who was interviewing Dr. Niedenthal about her research on facial expressions.

"At the end he said, 'So you are American?' " Dr. Niedenthal recalled.

Indeed, she is, although she was then living in France, where she had taken a post at Blaise Pascal University.

"So you know," the Russian reporter informed her, "that American smiles are all false, and French smiles are all true."

"Wow, it's so interesting that you say that," Dr. Niedenthal said diplomatically. Meanwhile, she was imagining what it would have been like to spend most of her life surrounded by fake smiles.

"I suddenly became interested in how people make these kinds of errors," Dr. Niedenthal said. But finding the source of the error would require knowing what smiles really are — where they come from and how people process them. And despite the fact that smiling is one of the most common things that we humans do, Dr. Niedenthal found science's explanation for it to be weak.

"I think it's pretty messed up," she said. "I think we don't know very much, actually, and it's something I want to take on."

To that end, Dr. Niedenthal and her colleagues have surveyed a wide range of studies, from brain scans to cultural observations, to build a new scientific model of the smile. They believe they can account not only for the source of smiles, but how people perceive them. In a recent issue of the journal Behavioral and Brain Sciences, they argue that smiles are not simply the expression of an internal feeling. Smiles in fact are only the most visible part of an intimate melding between two minds.

"It's an impressive, sophisticated analysis," said Adam Galinsky, a social psychologist at Northwestern University.

Psychologists have studied smiles carefully for decades, but mostly from the outside. When the zygomaticus major muscles in our cheeks contract, they draw up the corners of our mouths. But there's much more to a smile than that.

"A smile is not this floating thing, like a Cheshire Cat," said Dr. Niedenthal. "It's attached to a body." Sometimes the lips open to reveal teeth; sometimes they stay sealed. Sometimes the eyes crinkle. The chin rises with some smiles, and drops in others.

Cataloging these variations is an important first step, said Dr. Niedenthal, but it can't deliver an answer to the enigma of smiles. "People like to make dictionaries of the facial muscles to make a particular gesture, but there's no depth to that approach," she said.

Some researchers have tried to move deeper, to understand the states of mind that produce smiles. We think of them as signifying happiness, and indeed, researchers do find that the more intensely people contract their zygomaticus major muscles, the happier they say they feel. But this is far from an iron law. The same muscles sometimes contract when people are feeling sadness or disgust, for example.

The link between feelings and faces is even more mysterious. Why should any feeling cause us to curl up our mouths, after all? This is a question that Darwin pondered for years. An important clue, he said, is found in the faces of apes, which draw up their mouths as well. These expressions, Darwin argued, were also smiles. In other words, Mona Lisa inherited her endlessly intriguing smile from the grinning common ancestor she shared with chimpanzees.

Primatologists have been able to sort smiles into a few categories, and Dr. Niedenthal thinks that human smiles should be classified in the same way. Chimpanzees sometimes smile from pleasure, as when baby chimps play with each other. but chimpanzees also smile when they're trying to strengthen a social bond with another chimpanzee.

Dr. Niedenthal thinks that some human smiles fall into these categories as well. What's more, they may be distinguished by certain expressions. An embarrassed smile is often accompanied by a lowered chin, for example, while a smile of greeting often comes with raised eyebrows.

Chimpanzees sometimes smile not for pleasure or for a social bond, but for power. A dominant chimpanzee will grin and show its teeth. Dr. Niedenthal argues that humans flash a power grin as well — often raising their chin so as to look down at others.

" 'You're an idiot, I'm better than you'—that's what we mean by a dominant smile," said Dr. Niedenthal.

But making a particular facial expression is just the first step of a smile. Dr. Niedenthal argues that how another person interprets the smile is equally important. In her model, the brain can use three different means to distinguish a smile from some other expression.

One way people recognize smiles is comparing the geometry of a person's face to a standard smile. A second way is thinking about the situation in which someone is making an expression, judging if it's the sort where a smile would be expected.

But most importantly, Dr. Niedenthal argues, people recognize smiles by mimicking them. When a smiling person locks eyes with another person, the viewer unknowingly mimics a smile as well. In their new paper, Dr. Niedenthal and her colleagues point to a number of studies indicating that this imitation activates many of the same regions of the brain that are active in the smiler.

A happy smile, for example, is accompanied by activity in the brain's reward circuits, and looking at a happy smile can excite those circuits as well. Mimicking a friendly smile produces a different pattern of brain activity. It activates a region of the brain called the orbitofrontal cortex, which distinguishes feelings for people with whom we have a close relationship from others. The orbitofrontal cortex becomes active when parents see their own babies smile, for example, but not other babies.

If Dr. Niedenthal's model is correct, then studies of dominant smiles should reveal different patterns of brain activity. Certain regions associated with negative emotions should become active.

Embodying smiles not only lets people recognize smiles, Dr. Niedenthal argues. It also lets them recognize false smiles. When they unconsciously mimic a false smile, they don't experience the same brain activity as an authentic one. The mismatch lets them know something's wrong.

Other experts on facial expressions applaud Dr. Niedenthal's new model, but a number of them also think that parts of it require fine-tuning. "Her model fits really well along the horizontal dimension, but I have my doubts about the vertical," said Dr. Galinsky. He questions whether people observing a dominant smile would experience the feeling of power themselves. In fact, he points out, in such encounters, people tend to avoid eye contact, which Dr. Niedenthal says is central to her model.

Dr. Niedenthal herself is now testing the predictions of the model with her colleagues. In one study, she and her colleagues are testing the idea that mimicry lets people recognize authentic smiles. They showed pictures of smiling people to a group of students. Some of the smiles were genuine and others were fake. The students could readily tell the difference between them.

Then Dr. Niedenthal and her colleagues asked the students to place a pencil between their lips. This simple action engaged muscles that could otherwise produce a smile. Unable to mimic the faces they saw, the students had a much harder time telling which smiles were real and which were fake.

The scientists then ran a variation on the experiment on another group of students. They showed the same faces to the second group, but had them imagine the smiling faces belonged to salesclerks in a shoe store. In some cases the salesclerks had just sold the students a pair of shoes — in which they might well have a genuine smile of satisfaction. In other trials, they imagined that the salesclerks were trying to sell them a pair of shoes — in which case they might be trying to woo the customer with a fake smile.

In reality, the scientists use a combination of real and fake smiles for both groups of salesclerks. When the students were free to mimic the smiles, their judgments were not affected by what the salesclerk was doing.

But if the students put a pencil in their mouth, they could no longer rely on their mimicry. Instead, they tended to believe that the salesclerks who were trying to sell them shoes were faking their smiles — even when their smiles were genuine. Likewise, they tended to say that the salesclerks who had finished the sale were smiling for real, even when they weren't. In other words, they were forced to rely on the circumstances of the smile, rather than the smile itself.

Dr. Niedenthal and her colleagues have also been testing the importance of eye contact for smiles. They had students look at a series of portraits, like the "Laughing Cavalier" by the 17th-century artist Frans Hals. In some portraits the subject looked away from the viewer, while in others, the gaze was eye to eye. In some trials, the students looked at the paintings with bars masking the eyes.

The participants rated how emotional the impact of the painting was. Dr. Niedenthal and her colleagues found, as they had predicted, that people felt a bigger emotional impact when the eyes were unmasked than

when they were masked. The smile was identical in each painting, but it was not enough on its own. What's more, the differences were greater when the portrait face was making direct eye contact with the viewer.

Dr. Niedenthal suspects that she and other psychologists are just starting to learn secrets about smiles that artists figured out centuries ago. It may even be possible someday to understand why Mona Lisa's smile is so powerful. "I would say the reason it was so successful is because you achieve eye contact with her," said Dr. Niedenthal, "and so the fact that the meaning of her smile is complicated is doubly communicated, because your own simulation of it is mysterious and difficult."

http://www.nytimes.com/2011/01/25/science/25smile.html?ref=science

Harnessing the Brain's Right Hemisphere to Capture Many Kings

By DYLAN LOEB McCLAIN

Tom White for The New York Times

PROCESSING Pattern recognition is what sets experts apart from novices.

When inexperienced chess players sit down to play against experts, they probably wonder what it is that makes the experts so good that it seems they are almost playing a different game. New research suggests that one difference is that the experts use more of their brains.

In a study in the current issue of the journal PLoS One, a team of scientists in Germany showed experts and novices simple geometric objects and simple chess positions and asked the subjects to identify them.

Reaction times were measured and brain activity was monitored using functional M.R.I. scans. On the identification of the geometric objects, the subjects performed the same, showing that the chess experts had no special visualization skills. When the subjects were shown the chess positions, the experts identified them faster.

Focusing on an element of an earlier study on pattern and object recognition by chess experts, the researchers had expected to see parts of the left hemispheres of the experts' brains — which are involved in object recognition — react more quickly than those of the novices when they performed the chess tasks. But the reaction times were the same.

What set the experts apart was that parts of their right brain hemispheres — which are more involved in pattern recognition — also lit up with activity. The experts were processing the information in two places at once.

The researchers also found that when the subjects were shown the chess diagrams, the novices looked directly at the pieces to recognize them, while the experts looked on the middle of the boards and took everything in with their peripheral vision.

One of researchers, Merim Bilalic, a cognitive psychologist at the University of Tübingen in Germany, said in an interview that the way the experts' brains handled the chess tasks was more efficient. The study also showed that expertise is an acquired skill, not an innate one. "It tells you a very sobering message," he said. "It tells you there are no shortcuts to expertise."

In another study, reported Friday in Science, researchers at the Riken Brain Science Institute in Japan sought to discover which regions of the brain gave experts in shogi, a game similar to chess, their insights.

The scientists recruited beginning, intermediate and professional players. The subjects were shown different types of shogi positions and problems as well as chess diagrams, Chinese chess diagrams and photographs. They were asked to answer questions about each image and to solve some of the shogi positions, and their answers were timed.

The shogi experts reacted no more strongly to the chess and Chinese chess diagrams than amateurs, indicating that their expertise was highly specialized.

As in the German study, the subjects' brain activity was monitored using functional M.R.I. scans. The researchers found that there were two regions of the professionals' brains that were excited consistently when they were asked to solve the shogi problems.

One was the precuneus, which is in the superior parietal lobule, where perception and high-level thinking occur. The other area was the caudate nucleus, which is in the subcortical region.

The same areas were activated in the intermediate players' brains only when they were familiar with the patterns and had a reasonably good idea of how to solve the problems. The same areas were almost never activated in the brains of the beginners.

The significant role of the caudate nucleus was, at least on its surface, surprising because it is part of the basal ganglia, which, the researchers write, "is thought to be responsible for the formation and execution of habit" and for "goal directed behavior." Put another way, idea generation in the caudate nucleus is "quick and implicit," as opposed to conscious.

So, it seems, becoming a good chess or shogi player and wanting to win is habit-forming.

http://www.nytimes.com/2011/01/25/science/25chess.html?ref=science

Billions of Entangled Particles Advance Quantum Computing

By JOHN MARKOFF

In a step toward a generation of ultrafast computers, physicists have used bursts of radio waves to briefly create 10 billion quantum-entangled pairs of subatomic particles in silicon. The research offers a glimpse of a future computing world in which individual atomic nuclei store and retrieve data and single electrons shuttle it back and forth.

In a paper in the journal Nature, a team led by the physicists John Morton of Oxford University and Kohei Itoh of Keio University describes bombarding a three-dimensional crystal with microwave and radio frequency pulses to create the entangled pairs. This is one of a range of competing approaches to making qubits, the quantum computing equivalent of today's transistors.

Transistors store information on the basis of whether they are on or off. In the experiment, qubits store information in the form of the orientation, or spin, of an atomic nucleus or an electron. The storage ability is dependent on entanglement, in which a change in one particle instantaneously affects another particle even if they are widely separated. The new approach has significant potential, scientists said, because it might permit quantum computer designers to exploit low-cost and easily manufacturable components and technologies now widely used in the consumer electronics industry.

"I think this is a very neat piece of work," said Raymond Laflamme, a physicist at the University of Waterloo in Ontario, "but I think it's important to see it as a piece of a big puzzle. Our mecca is to build a quantum computer that could have thousands of qubits; here we have only a few."

Indeed, there is still disagreement over whether scientific or commercially useful quantum computers will ever be built. Until now, scientists have designed prototypes based on only a handful of qubits, too few to gain meaningful speed over conventional computers.

In today's binary computers, transistors can be in either an "on" or an "off" state, but quantum computing exploits the notion of superposition, in which a qubit can be constructed to represent both a 1 and a zero state simultaneously.

The potential power of quantum computing comes from the possibility of performing a mathematical operation on both states simultaneously. In a two-qubit system it would be possible to compute on four values at once, in a three-qubit system on eight, in a four-qubit system on 16, and so on. As the number of qubits grows, potential processing power increases exponentially.

There is, of course, a catch. The mere act of measuring or observing a qubit can strip it of its computing potential. So researchers have used quantum entanglement — in which particles are linked so that measuring a property of one instantly reveals information about the other, no matter how far apart the two particles are — to extract information. But creating and maintaining qubits in entangled states has been tremendously challenging.

The new approach is based on a purified silicon isotope doped with phosphorus atoms. The research group was able to create and measure vast numbers of quantum-entangled pairs of atomic nuclei and electrons when the crystal was cooled to about 3 kelvin. The group hopes to produce the basis for a quantum computing system by moving the entangled electrons to simultaneously entangle them with a second nucleus.

"We would move the electron from the nuclear spin it is on to the neighboring nuclear spin," said Dr. Morton. "That shifting step is what we really now need to show works while preserving entanglement."

One of the principal advantages of the new silicon-based approach is that the group believes that it will be able to maintain the entangled state needed to preserve quantum information as long as several seconds, far longer than competing technologies which currently measure the persistence of entanglement for billionths of a second.

“To a member of the general public, that still sounds like a lousy time for a computer memory,” Dr. Morton said. “But for quantum information, the lifetime of a second is very exciting,” because there are ways to refresh data.

The advance indicates there is an impending convergence between the subatomic world of quantum computers and today’s classical microelectronic systems, which are reaching a level of miniaturization in which wires and devices are composed of just dozens or hundreds of atoms.

“This is on a single-nucleus scale, but it isn’t that far away from what is being used today,” said Stephanie Simmons, a graduate physics researcher at Oxford and the lead author of the paper. “There are two reasons people are taking a look at quantum computing. One is its power, but the other is that the size of silicon transistors are shrinking to the point where quantum effects are becoming important.”

http://www.nytimes.com/2011/01/25/science/25spin.html?ref=science

Evolution by Mistake: Major Driving Force Comes from How Organisms Cope With Errors at Cellular Level

Just like erasing misspellings on a whiteboard, organisms have evolved mechanisms to deal with errors that pop up when genetic information is translated into proteins. Joanna Masel (left) and Etienne Rajon discovered that such errors help organisms adapt to evolutionary challenges. Here, they write "GATTACA" on a whiteboard, for the 1997 movie spelled with letters of the genetic alphabet. (Credit: Beatriz Verdugo/UANews)

ScienceDaily (Jan. 25, 2011) — Charles Darwin based his groundbreaking theory of natural selection on the realization that genetic variation among organisms is the key to evolution.

Some individuals are better adapted to a given environment than others, making them more likely to survive and pass on their genes to future generations. But exactly how nature creates variation in the first place still poses somewhat of a puzzle to evolutionary biologists.

Now, Joanna Masel, associate professor in the UA's department of ecology and evolutionary biology, and postdoctoral fellow Etienne Rajon discovered the ways organisms deal with mistakes that occur while the genetic code in their cells is being interpreted greatly influences their ability to adapt to new environmental conditions -- in other words, their ability to evolve.

"Evolution needs a playground in order to try things out," Masel said. "It's like in competitive business: New products and ideas have to be tested to see whether they can live up to the challenge."

The finding is reported in a paper published in the journal *Proceedings of the National Academy of Sciences*.

In nature, it turns out, many new traits that, for example, enable their bearers to conquer new habitats, start out as blunders: mistakes made by cells that result in altered proteins with changed properties or functions that are new altogether, even when there is nothing wrong with the gene itself. Sometime later, one of these mistakes can get into the gene and become more permanent.

"If the mechanisms interpreting genetic information were completely flawless, organisms would stay the same all the time and be unable to adapt to new situations or changes in their environment," said Masel, who is also a member of the UA's BIO5 Institute.

Living beings face two options of handling the dangers posed by errors, Masel and Rajon wrote. One is to avoid making errors in the first place, for example by having a proofreading mechanism to spot and fix errors as they arise. The authors call this a global solution, since it is not specific to any particular mistake, but instead watches over the entire process.

The alternative is to allow errors to happen, but evolve robustness to the effects of each of them. Masel and Rajon call this strategy a local solution, because in the absence of a global proofreading mechanism, it requires an organism to be resilient to each and every mistake that pops up.

"We discovered that extremely small populations will evolve global solutions, while very large populations will evolve local solutions," Masel said. "Most realistically sized populations can go either direction but will gravitate toward one or the other. But once they do, they rarely switch, even over the course of evolutionary time."

Using what is known about yeast, a popular model organism in basic biological research, Masel and Rajon formulated a mathematical model and ran computer simulations of genetic change in populations.

Avoiding or fixing errors comes at a cost, they pointed out. If it didn't, organisms would have evolved nearly error-free accuracy in translating genetic information into proteins. Instead, there is a trade-off between the cost of keeping proteins free of errors and the risk of allowing potentially deleterious mistakes.

In previous publications, Masel's group introduced the idea of variation within a population producing "hopeful and hopeless monsters" -- organisms with genetic changes whose consequences can be either mostly harmless or deadly, but rarely in between.

In the present paper, Masel and Rajon report that natural variation comes in two flavors: regular variation, which is generally bad most of the time, since the odds of a genetic mutation leading to something useful or even better are pretty slim, and what they call cryptic variation, which is less likely to be deadly, and more likely to be mostly harmless.

So how does cryptic variation work and why is it so important for understanding evolution?

By allowing for a certain amount of mistakes to occur instead of quenching them with global proofreading machinery, organisms gain the advantage of allowing for what Masel calls pre-selection: It provides an opportunity for natural selection to act on sequences even before mutations occur.

"There is evidence that cryptic gene sequences still get translated into protein," Masel explained, "at least occasionally."

"When those proteins are bad enough, the sequences that produce them can be selected against. For example, if we imagine a protein with an altered amino acid sequence causing it to not fold correctly and pile up inside the cell, that would be very toxic to the organism."

"In this case of a misfolded protein, selection would favor mutations causing that genetic sequence to not be translated into protein or it would favor sequences in which there is a change so that even if that protein is made by accident, the altered sequence would be harmless."

"Pre-selection puts that cryptic variation in a state of readiness," Masel said. "One could think of local solutions as natural selection going on behind the scenes, weeding out variations that are going to be catastrophic, and enriching others that are only slightly bad or even harmless."

"Whatever is left after this process of pre-selection has to be better," she pointed out. "Therefore, populations relying on this strategy have a greater capability to evolve in response to new challenges. With too much proofreading, that pre-selection can't happen."

"Most populations are fairly well adapted and from an evolutionary perspective get no benefit from lots of variation. Having variation in a cryptic form gets around that because the organism doesn't pay a large cost for it, but it's still there if it needs it."

According to Masel, studying how nature creates innovation holds clues for human society as well.

"We find that biology has a clever solution. It lets lots of ideas flourish, but only in a cryptic form and even while it's cryptic, it weeds out the worst ideas. This is an extremely powerful and successful strategy. I think companies, governments, economics in general can learn a lot on how to foster innovation from understanding how biological innovation works."

This study was funded by the National Institutes of Health, or NIH, and through a scholarship awarded to Masel by the Pew Charitable Trusts.

Story Source:

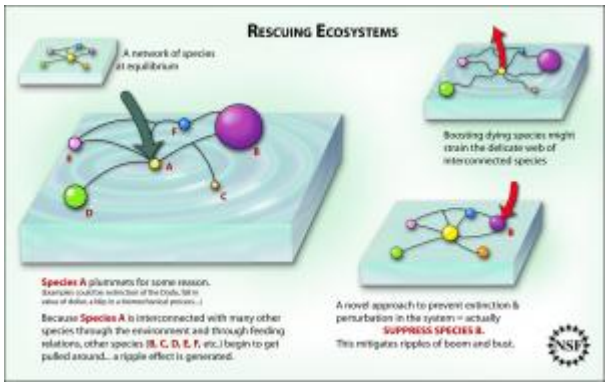
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Arizona**. The original article was written by Daniel Stolte, University Communications.

Journal Reference:

1. E. Rajon, J. Masel. **Evolution of molecular error rates and the consequences for evolvability**. *Proceedings of the National Academy of Sciences*, 2011; DOI: 10.1073/pnas.1012918108

http://www.sciencedaily.com/releases/2011/01/110125172418.htm

Mathematical Model Could Help Predict and Prevent Future Extinctions



When an ecosystem is healthy, food, territory and other resources are balanced among species, as depicted in the top left diagram. If a key species or network component drastically decreases, an entire system may be disrupted as shown on the left. Aiding the troubled species or component, the approach illustrated in the top right image, may further strain the connections in the network, perpetuating the imbalance. A newly developed mathematical model suggests some extinctions or network failures can be avoided and the network can be rebalanced by suppressing, rather than enhancing, one or more members of the network, bottom right. (Credit: Zina Deretsky, National Science Foundation)

ScienceDaily (Jan. 25, 2011) — In an effort to better understand the dynamics of complex networks, scientists have developed a mathematical model to describe interactions within ecological food webs. This research, performed by Northwestern University physics professor Adilson Motter and his student, Sagar Sahasrabudhe, is published in the January 25 issue of *Nature Communications*. The work illustrates how human intervention may effectively aid species conservation efforts.

"Our study provides a theoretical basis for management efforts that would aim to mitigate extinction cascades in food web networks. There is evidence that a significant fraction of all extinctions are caused not by a primary perturbation but instead by the propagation of a cascade," said Motter.

Extinction cascades are often observed following the loss of a key species within an ecosystem. As the system changes to compensate for the loss, availability of food, territory and other resources to each of the remaining members can fluctuate wildly, creating a boom-or-bust environment that can lead to even more extinctions. According to the study, more than 70 percent of these extinctions are preventable, assuming that the system can be brought into balance using only available resources--no new factors may be introduced.

Motter explained further, "We find that extinction cascades can often be mitigated by suppressing--rather than enhancing--the populations of specific species. In numerous cases, it is predicted that even the proactive removal of a species that would otherwise be extinct by a cascade can prevent the extinction of other species."

The finding may seem counterintuitive to conservationists because the compensatory actions seem to inflict further damage to the system. However, when the entire ecosystem is considered, the effect is beneficial. This news holds promise for those charged with maintaining Earth's biodiversity and natural resources--the health of which can counteract many of the causes of climate change, and some man-made disasters such as the Gulf of Mexico oil spill.

The dodo bird, *Raphus cucullatus*, is one example of extinction due to human activity. The dodo was a large, flightless bird that became extinct in the 1600s. It is likely that a combination of factors including hunting, loss of habitat, and perhaps even a flash flood, stressed the ecosystem on the island of Mauritius, home of the

dodo. Some researchers think that human introduction of non-native species, such as dogs, pigs, cats and rats to the island, is what ultimately lead to the demise of the dodo.

In any case, in the future, it may be possible to avoid extinction of some species in stressed ecosystems by applying the new method of analysis developed by Motter.

The goal of this project, funded by the National Science Foundation's Division of Mathematical Sciences, is to develop mathematical methods to study dynamical processes in complex networks. Although the specific application mentioned here may be useful in management of ecosystems, the mathematical foundation underlying the analysis is much more universal. The broad concept is innovative in the area of complex networks because it concludes that large-scale failures can be avoided by focusing on preventing the waves of failure that follow the initial event.

This approach could be used to stabilize a wide array of complex networks. It can apply to biochemical networks in order to slow or stop progression of diseases caused by variations inside individual cells. It can also be used to manage technological networks such as the smart grid to prevent blackouts. It can even apply to regulation of complicated financial networks by identifying key factors in the early stages of a financial downturn, which, when met with human intervention, could potentially save billions of dollars.

The world is a complicated place that gets even trickier when trying to mathematically explain a complex network, especially when the network evolves within an environment that is itself changing. But, Motter says his mathematical model is promising for the study of changing environments.

"Uncertainty itself is not a problem," he quipped. "The problem comes when you cannot estimate uncertainty."

Story Source:

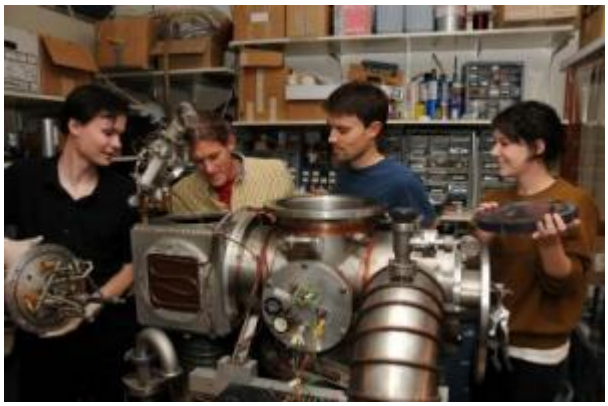
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Science Foundation**.

Journal Reference:

1. Sagar Sahasrabudhe, Adilson E. Motter. **Rescuing ecosystems from extinction cascades through compensatory perturbations**. *Nature Communications*, 2011; 2: 170 DOI: 10.1038/ncomms1163

http://www.sciencedaily.com/releases/2011/01/110125172439.htm

Van-Der-Waals Force Up Close: Physicists Take New Look at the Atom



Graduate student Vincent Lonij (left), associate professor of physics Alex Cronin, research assistant Will Holmgren and undergraduate student Catherine Klauss perform maintenance on a chamber used to beam atoms through a grating to measure a tiny force that helps physicists better understand the structure of atoms. (Credit: Norma Jean Gargasz/UANews)

ScienceDaily (Jan. 25, 2011) — Measuring the attractive forces between atoms and surfaces with unprecedented precision, University of Arizona physicists have produced data that could refine our understanding of the structure of atoms and improve nanotechnology.

The discovery has been published in the journal *Physical Review Letters*.

Van der Waals forces are fundamental for chemistry, biology and physics. However, they are among the weakest known chemical interactions, so they are notoriously hard to study. This force is so weak that it is hard to notice in everyday life. But delve into the world of micro-machines and nano-robots, and you will feel the force -- everywhere.

"If you make your components small enough, eventually this van-der-Waals potential starts to become the dominant interaction," said Vincent Lonij, a graduate student in the UA department of physics who led the research as part of his doctoral thesis.

"If you make tiny, tiny gears for a nano-robot, for example, those gears just stick together and grind to a halt. We want to better understand how this force works."

To study the van-der-Waals force, Lonij and his co-workers Will Holmgren, Cathy Klauss and associate professor of physics Alex Cronin designed a sophisticated experimental setup that can measure the interactions between single atoms and a surface. The physicists take advantage of quantum mechanics, which states that atoms can be studied and described both as particles and as waves.

"We shoot a beam of atoms through a grating, sort of like a micro-scale picket fence," Lonij explained. "As the atoms pass through the grating, they interact with the surface of the grating bars, and we can measure that interaction."

As the atoms pass through the slits in the grating, the van-der-Waals force attracts them to the bars separating the slits. Depending on how strong the interaction, it changes the atom's trajectory, just like a beam of light is bent when it passes through water or a prism.

A wave passing through the middle of the slit does so relatively unencumbered. On the other hand, if an atom wave passes close by the slit's edges, it interacts with the surface and skips a bit ahead, "out of phase," as physicists say.

"After the atoms pass through the grating, we detect how much the waves are out of phase, which tells us how strong the van-der-Waals potential was when the atoms interacted with the surface."

Mysterious as it seems, without the van-der-Waals force, life would be impossible. For example, it helps the proteins that make up our bodies to fold into the complex structures that enable them to go about their highly specialized jobs.

Unlike magnetic attraction, which affects only metals or matter carrying an electric current, van-der-Waals forces make anything stick to anything, provided the two are extremely close to each other. Because the force is so weak, its action doesn't range beyond the scale of atoms -- which is precisely the reason why there is no evidence of such a force in our everyday world and why we leave it to physicists such as Lonij to unravel its secrets.

Initially, he was driven simply by curiosity, Lonij said. When he started his project, he didn't know it would lead to a new way of measuring the forces between atoms and surfaces that may change the way physicists think about atoms.

And with a smile, he added, "I thought it would be fitting to study this force, since I am from the Netherlands; Mr. van der Waals was Dutch, too."

In addition to proving that core electrons contribute to the van-der-Waals potential, Lonij and his group made another important discovery.

Physicists around the world who are studying the structure of the atom are striving for benchmarks that enable them to test their theories about how atoms work and interact. "Our measurements of atom-surface potentials can serve as such benchmarks," Lonij explained. "We can now test atomic theory in a new way."

Studying how atoms interact is difficult because they are not simply tiny balls. Instead, they are what physicists call many-body systems. "An atom consists of a whole bunch of other particles, electrons, neutrons, protons, and so forth," Lonij said.

Even though the atom as a whole holds no net electric charge, the different charged particles moving around in its interior are what create the van-der-Waals force in the first place.

"What happens is that the electrons, which hold all the negative charge, and the protons, which hold all the positive charge, are not always in the same places. So you can have tiny little differences in charge that are fluctuating very fast. If you put a charge close to a surface, you induce an image charge. In a highly simplified way, you could say the atom is attracted to its own reflection."

To physicists, who prefer things neat and clean and tractable with razor-sharp mathematics, such a system, made up from many smaller particles zooming around each other, is difficult to pin down. To add to the complication, most surfaces are not clean. As Lonij puts it, "Comparing such a dirty system to theory is a big challenge, but we figured out a way to do it anyway."

"A big criticism of this type of work always was, 'well, you're measuring this atom-surface potential, but you don't know what the surface looks like so you don't know what you're really measuring.'"

To eliminate this problem, Lonij's team used different types of atoms and looked at how each interacted with the same surface.

"Our technique gives you the ratio of potentials directly without ever knowing the potential for either of the two atoms," he said. "When I started five years ago, the uncertainty in these types of measurements was 20 percent. We brought it down to two percent."

The most significant discovery was that an atom's inner electrons, orbiting the nucleus at a closer range than the atom's outer electrons, influence the way the atom interacts with the surface.

"We show that these core electrons contribute to the atom-surface potential," Lonij said, "which was only known in theory until now. This is the first experimental demonstration that core electrons affect atom-surface potentials."

"But what is perhaps more important," he added, "is that you can also turn it around. We now know that the core electrons affect atom-surface potentials. We also know that these core electrons are hard to calculate in atomic theory. So we can use measurements of atom-surface potentials to make the theory better: The theory of the atom."

Story Source:

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

Journal Reference:

1. Vincent Lonij, Catherine Klauss, William Holmgren, Alexander Cronin. **Atom Diffraction Reveals the Impact of Atomic Core Electrons on Atom-Surface Potentials**. *Physical Review Letters*, 2010; 105 (23) DOI: 10.1103/PhysRevLett.105.233202

http://www.sciencedaily.com/releases/2011/01/110125172422.htm

Biologists' Favorite Worm Gets Viruses: Finding Means C. Elegans May Aid Studies of Human Infections

Scientists have discovered that C. elegans, a microscopic worm biologists have used in the lab to identify important biological phenomena, suffers from natural viral infections. This may mean that C. elegans can help scientists learn more about how hosts and viruses interact. (Credit: Marie-Anne Felix, the Monod Institute)

ScienceDaily (Jan. 25, 2011) — A workhorse of modern biology is sick, and scientists couldn't be happier.

Researchers at Washington University School of Medicine in St. Louis, the Jacques Monod Institute in France and Cambridge University have found that the nematode *C. elegans*, a millimeter-long worm used extensively for decades to study many aspects of biology, gets naturally occurring viral infections.

The discovery means *C. elegans* is likely to help scientists study the way viruses and their hosts interact.

"We can easily disable any of *C. elegans'* genes, confront the worm with a virus and watch to see if this makes the infection worse, better or has no effect," says David Wang, PhD. "If it changes the worm's response to infection, we will look to see if similar genes are present in humans and other mammals."

Wang, associate professor of pathology and immunology and of molecular microbiology at Washington University School of Medicine, says that several fundamental aspects of human biology, including the ability of cells to self-destruct to prevent cancer, and RNA interference, an important process for regulating how genes are used to make proteins, were first identified in *C. elegans* and later affirmed to be present in humans.

The findings appear online in *PLoS Biology*.

Marie-Anne Felix, PhD, a researcher who studies nematodes at the Monod Institute, began the study by gathering *C. elegans* from rotting fruit in French orchards. Felix noted that some of her sample worms appeared to be sick. Treatment with antibiotics failed to cure them.

Felix then repeated a classic biology experiment that led to the discovery of viruses.

"She ground up the sick worms, passed them through a filter fine enough to remove any bacterial or parasitic infectious agents and exposed a new batch of worms to the ground-up remains of the first batch," Wang says. "When the new batch got sick, she knew that a viral infection was likely to be present."

Wang specializes in the identification of novel viruses. He found the worms had been suffering infections from two viruses related to nodaviruses, a class of viruses previously found to infect insects and fish. Nodaviruses are not currently known to infect humans. Tests showed one of the new viruses can infect the strain of *C. elegans* most commonly used in research.

"Model organisms are essential to important steps forward in biology, and we're eager to see what *C. elegans* can teach us about the way hosts and viruses interact," Wang says.

Story Source:

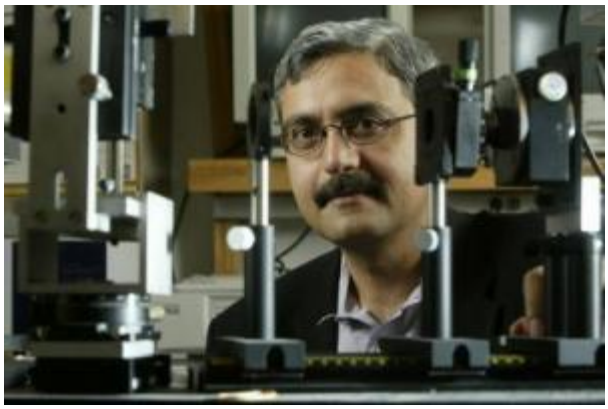
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Washington University School of Medicine**. The original article was written by Michael C. Purdy.

Journal Reference:

1. Marie-Anne Félix, Alyson Ashe, Joséphine Piffaretti, Guang Wu, Isabelle Nuez, Tony Bélicard, Yanfang Jiang, Guoyan Zhao, Carl J. Franz, Leonard D. Goldstein, Mabel Sanroman, Eric A. Miska, David Wang. **Natural and Experimental Infection of Caenorhabditis Nematodes by Novel Viruses Related to Nodaviruses**. *PLoS Biology*, 2011; 9 (1): e1000586 DOI: 10.1371/journal.pbio.1000586

http://www.sciencedaily.com/releases/2011/01/110125172317.htm

Human-Made DNA Sequences Made Easy: New Method for Rapidly Producing Protein-Polymers



This is Ashutosh Chilkoti of Duke University. (Credit: Duke University Photography)

ScienceDaily (Jan. 25, 2011) — Duke University bioengineers have developed a new method for rapidly producing an almost unlimited variety of human-made DNA sequences.

These novel sequences of recombinant DNA are used to produce repetitive proteins to create new types of drugs and bioengineered tissues. Current methods for producing these DNA sequences are slow or not robust, the researchers said, which has hindered the development of these increasingly important new classes of protein-based polymers.

Researchers have already demonstrated that when a large protective macromolecule -- known as a polymer -- is attached to a protein, it greatly improves effectiveness and allows the protein to remain active in the bloodstream longer. There are many protein-polymer based medications in use today, such as human growth hormones, drugs to stimulate blood cell formation in cancer patients and anti-viral agents.

"This new technique should be very useful in making a practically unlimited number of these protein building blocks," said Ashutosh Chilkoti, Theo Pilkington Professor of Biomedical Engineering at Duke's Pratt School of Engineering. The results of the Duke team's experiment were published online in the journal *Nature Materials*. Graduate students Miriam Amiram and Felipe García Quiroz, working in Chilkoti's lab, were co-first authors of this paper.

"Depending on how complicated you want the polymer sequence to be, there are an infinite number of combinations you could make," Chilkoti said. "We haven't even begun to look at all the sequences that can be made or the unique properties they might have."

The researchers call the new process overlap-extension rolling circle amplification, and it is a modification of existing technologies. Because of this, they said that other laboratories would not need major investments in new equipment or materials.

"A very popular method for making tandem copies of DNA sequences involves inserting them iteratively into a bacterial plasmid," Amiram said. "After the vector has grown in size, the copies of the sequence are cut out using enzymes and the process is repeated to generate a larger polymer. It is a very time-consuming process.

"With this new method, you don't get just one product, but many," she said. "This should help us to make large libraries of proteins, which we can use to rapidly screen new combinations. This powerful strategy generates libraries of repetitive genes over a wide range of molecular weights in a 'one-pot' parallel format."

Chilkoti compared it to sausage-making. Instead of stuffing the casings one-by-one individually, the new tool can rapidly stuff and stitch together long strings of sausages.

"This could help remove one of the biggest stumbling blocks we face in producing these drugs," Chilkoti said. "You can't make the proteins without genes, which act as the software directing the protein's production. Instead of building each sequence individually, as is done now, we can literally make hundreds, each with subtle differences."

The researchers used the system to synthesize genes found in two classes of protein-polymers. In the first, they produced protein-polymer combinations for elastin, a ubiquitous protein found in connective tissue. The researchers term them "smart" protein-polymers because they can be controlled by heat.

In the second set of experiments, they rapidly synthesized novel glucagon-like peptide-1 (GLP-1) analogs to show variable pharmokinetic properties. GLP-1 is a hormone that acts to release insulin in the body.

The research was supported by the National Institutes of Health. The other member of the team from Duke was Daniel Callahan.

Story Source:

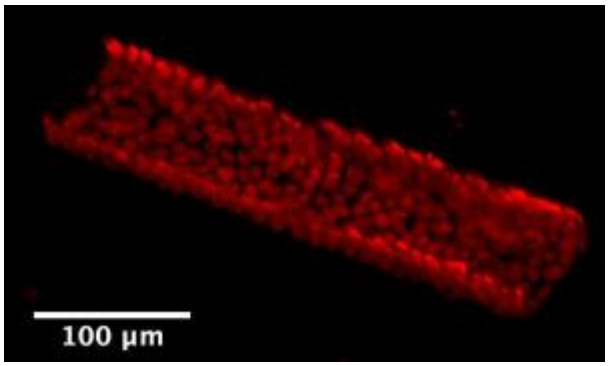
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Duke University**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Miriam Amiram, Felipe Garcia Quiroz, Daniel J. Callahan, Ashutosh Chilkoti. **A highly parallel method for synthesizing DNA repeats enables the discovery of 'smart' protein polymers**. *Nature Materials*, 2011; DOI: 10.1038/nmat2942

http://www.sciencedaily.com/releases/2011/01/110125152518.htm

'Breast on a Chip': Researchers Create 'Engineered Organ' Model for Breast Cancer Research



This image shows a 3-D rendering of one of the channels lined with cells from a new model that will be used to test nanomedical approaches for the detection and treatment of breast cancer. (Credit: Purdue University/Lelièvre laboratory - reproduced by permission of The Royal Society of Chemistry)

ScienceDaily (Jan. 25, 2011) — Purdue University researchers have reproduced portions of the female breast in a tiny slide-sized model dubbed "breast on-a-chip" that will be used to test nanomedical approaches for the detection and treatment of breast cancer.

The model mimics the branching mammary duct system, where most breast cancers begin, and will serve as an "engineered organ" to study the use of nanoparticles to detect and target tumor cells within the ducts.

Sophie Lelièvre, associate professor of basic medical sciences in the School of Veterinary Medicine, and James Leary, SVM Professor of Nanomedicine and professor of basic medical sciences in the School of Veterinary Medicine and professor of biomedical engineering in the Weldon School of Biomedical Engineering, led the team.

"Breast cancer is the most common cancer in women in most countries, and in the U.S. alone nearly 40,000 women lost their lives to it this past year," said Lelièvre, who is associate director of discovery groups in the Purdue Center for Cancer Research and a leader of the international breast cancer and nutrition project in the Oncological Sciences Center. "We've known that the best way to detect this cancer early and treat it effectively would be to get inside the mammary ducts to evaluate and treat the cells directly, and this is the first step in that direction."

Lelièvre and Leary hope eventually to be able to introduce magnetic nanoparticles through openings in the nipple, use a magnetic field to guide them through the ducts where they would attach to cancer cells and then reverse the magnetic field to retract any excess nanoparticles.

The nanoparticles could carry contrast agents to improve mammography, fluorescent markers to guide surgeons or anticancer agents to treat the cancer, Leary said.

"Nanoparticles can be designed to latch on to cancer cells and illuminate them, decreasing the size of a tumor that can be detected through mammography from 5 millimeters to 2 millimeters, which translates into finding the cancer 10 times earlier in its evolution," Leary said. "There also is great potential for nanoparticles to deliver anticancer agents directly to the cancer cells, eliminating the need for standard chemotherapy that circulates through the entire body causing harmful side effects."

Physicians have tried to access the mammary ducts through the nipple in the past, injecting fluid solutions to try to wash out cells that could be examined and used for a diagnosis of cancer. However, this approach could

only reach the first third of the breast due to fluid pressure from the ducts, which branch and become smaller and smaller as they approach the glands that produce milk, Leary said.

"The idea is that nanoparticles with a magnetic core can float through the naturally occurring fluid in the ducts and be pulled by a magnet as opposed to being pushed with pressure," he said. "We think they could reach all the way to the back of the ducts, where it is believed most breast cancers originate. Of course, we are only at the earliest stages and many tests need to be done."

Such tests could not be done using standard models that grow cells across a flat surface in a plastic dish, so the team created the artificial organlike model in which living cells line a three-dimensional replica of the smallest portions of the mammary ducts.

Leary is internationally known for his nanofabrication work using photolithography to build tiny, precise structures on thin pieces of silicon to create high-speed cell sorting and analysis tools. He used the same techniques to build a mold of branching channels out of a rubberlike material called polydimethylsiloxane. The channels are about 5 millimeters long of various diameters from 20 microns to 100 microns, roughly the diameter of a human hair, that match what is found near the end of the mammary duct system.

Lelièvre, whose group is one of the few in the world able to successfully grow the complicated cells that line the mammary ducts, coaxed the cells to grow within the mold and behave as they would within a real human breast.

"The cells within the breast ductal system have a very specific organization that has proven difficult to obtain in a laboratory," Lelièvre said. "The cells have different sides, and one side must face the wall of the duct and the other must face the inner channel. Reproducing this behavior is very challenging, and it had never been achieved on an artificial structure before."

The team coated the mold in a protein-based substance called laminin 111 as a foundation for the cells that allows them to attach to the mold and behave as they would inside the body, Lelièvre said.

Because injecting the delicate cells into the finished channels of the mold caused too much damage, the team created a removable top for the channels.

"The design of the U-shaped channels and top was necessary for us to be able to successfully apply the cells, but it also allows us to make changes quickly and easily for different tests," Lelièvre said. "We can easily introduce changes among the cells or insert a few tumor cells to test the abilities of the nanoparticles to recognize them. The design also makes it very easy to evaluate the results as the entire model fits under a microscope."

A paper detailing the team's work, which was funded by the U.S. Department of Defense, is published in the current issue of *Integrative Biology*. In addition to Lelièvre and Leary, co-authors include graduate student Meggie Grafton, research associate Lei Wang and postdoctoral researcher Pierre-Alexandre Vidi.

The team has demonstrated that nanoparticles can be moved within the bare channels of the mold filled with fluid, but has not yet moved nanoparticles through the finished model lined with living cells, Lelièvre said.

The team next plans to create and test nanoparticles with a slippery surface that will prevent them from sticking to the cells as they travel through the channels and coatings that contain antibodies to target and attach to specific types of cancerous and precancerous cells, she said.

"Although we are at the very beginning stages of this work, we are hopeful that this nanomedical approach will one day save lives and provide patients with an easier road to recovery," Lelièvre said. "The successful creation of this model is an important milestone in this work and it is a testament to what can be accomplished through multidisciplinary research."

Lelièvre and Leary are both members of the Purdue Center for Cancer Research and the Oncological Sciences Center. Leary also is a member of the Birck Nanotechnology Center and Bindley Bioscience Center at Purdue's Discovery Park.

Story Source:

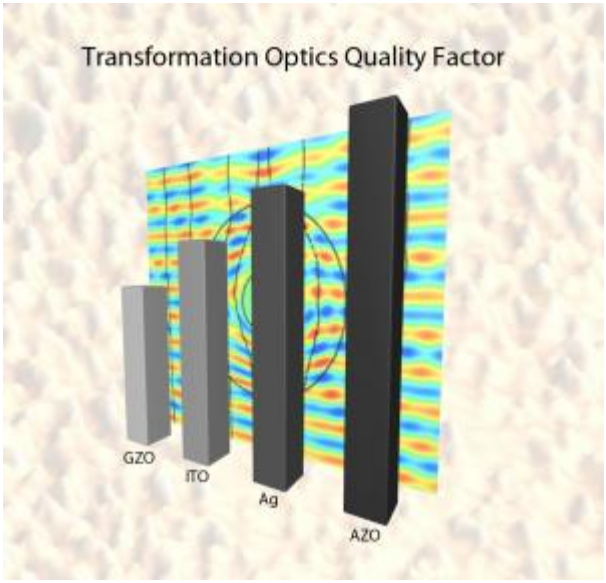
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Purdue University**. The original article was written by Elizabeth K. Gardner.

Journal Reference:

1. Meggie M.G. Grafton, Lei Wang, Pierre-Alexandre Vidi, James Leary, Sophie A. Lelièvre. **Breast on-a-chip: mimicry of the channeling system of the breast for development of theranostics**. *Integrative Biology*, 2011; DOI: 10.1039/c0ib00132e

http://www.sciencedaily.com/releases/2011/01/110124184430.htm

New Materials May Bring Advanced Optical Technologies, Cloaking



Researchers are developing a new class of "plasmonic metamaterials" as potential building blocks for advanced optical technologies and a range of potential breakthroughs in the field of transformation optics. This image shows the transformation optics "quality factor" for several plasmonic materials. For transformation optical devices, the quality factor rises as the amount of light "lost," or absorbed, by plasmonic materials falls, resulting in materials that are promising for a range of advanced technologies. (Credit: Birck Nanotechnology Center, Purdue University)

ScienceDaily (Jan. 25, 2011) — Researchers are developing a new class of "plasmonic metamaterials" as potential building blocks for advanced optical technologies, including ultrapowerful microscopes and computers, improved solar cells, and a possible invisibility cloak.

The new materials could make possible "nanophotonic" devices for numerous applications, said Alexandra Boltasseva, an assistant professor of electrical and computer engineering at Purdue University.

Unlike natural materials, metamaterials may possess an index of refraction less than one or less than zero. Refraction occurs as electromagnetic waves, including light, bend when passing from one material into another. It causes the bent-stick-in-water effect, which occurs when a stick placed in a glass of water appears crooked when viewed from the outside.

Being able to create materials with an index of refraction that's negative or between one and zero promises a range of potential breakthroughs in a new field called transformation optics. However, development of new technologies using metamaterials has been hindered by two major limitations: too much light is "lost," or absorbed by metals such as silver and gold contained in the metamaterials, and the materials need to be more precisely tuned so that they possess the proper index of refraction.

Now, researchers are proposing a new approach to overcome these obstacles. Findings will be detailed in an article appearing Jan. 21 in the journal *Science*. The article was written by Boltasseva and Harry Atwater, Howard Hughes Professor and a professor of applied physics and materials science at the California Institute of Technology.

The researchers are working to replace silver and gold in materials that are created using two options: making semiconductors more metallic by adding metal impurities to them; or adding non-metallic elements to metals, in effect making them less metallic. Examples of these materials include aluminum oxides and titanium nitride, which looks like gold and is used to coat the domes of Russian churches.

Researchers have tested some of the new materials, demonstrating their optical properties and finding that they outperform silver and gold, in work based at the Birck Nanotechnology Center in Purdue's Discovery Park.

Plasmonic metamaterials are promising for various advances, including a possible "hyperlens" that could make optical microscopes 10 times more powerful and able to see objects as small as DNA; advanced sensors; new types of light-harvesting systems for more efficient solar cells; computers and consumer electronics that use light instead of electronic signals to process information; and a cloak of invisibility.

Optical nanophotonic circuits might harness clouds of electrons called "surface plasmons" to manipulate and control the routing of light in devices too tiny for conventional lasers.

Some of the new materials are showing promise in uses involving near-infrared light, the range of the spectrum critical for telecommunications and fiberoptics. Other materials also might work for light in the visible range of the spectrum. The new materials might be tuned so that their refractive index is ideal for specific ranges of the spectrum, allowing their use for particular applications.

Future photonics technologies will revolve around new types of optical transistors, switches and data processors. Conventional computers transmit and process pieces of information in serial form, or one piece at a time. However, future computers may use parallel streams of data, resulting in much faster networks and computers.

The work has been funded by the U.S. Army Research Office.

Story Source:

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

Journal Reference:

1. A. Boltasseva, H. A. Atwater. **Low-Loss Plasmonic Metamaterials**. *Science*, 2011; 331 (6015): 290 DOI: 10.1126/science.1198258

http://www.sciencedaily.com/releases/2011/01/110125104143.htm

Rogue Storm System Caused Pakistan Floods That Left Millions Homeless

This photo, taken long after the initial floods hit in late July 2010, shows the significant effect of the monsoon on roads in the Muzaffargarrh district near central Pakistan. (Credit: World Vision)

ScienceDaily (Jan. 25, 2011) — Last summer's disastrous Pakistan floods that killed more than 2,000 people and left more than 20 million injured or homeless were caused by a rogue weather system that wandered hundreds of miles farther west than is normal for such systems, new research shows.

Storm systems that bring widespread, long-lasting rain over eastern India and Bangladesh form over the Bay of Bengal, at the east edge of India, said Robert Houze, a University of Washington atmospheric sciences professor. But Pakistan, on the Arabian Sea west of India, is substantially more arid and its storms typically produce only locally heavy rainfall.

The flooding began in July and at one point it was estimated that 20 percent of Pakistan's total land area was under water. Structural damage was estimated at more than $4 billion, and the World Health Organization estimated that as many as 10 million people had to drink unsafe water.

Houze and colleagues examined radar data from the Tropical Rainfall Measuring Mission satellite and were able to see that the rainfall that caused the Indus River in Pakistan to overflow was triggered over the Himalayas, within a storm system that had formed over the Bay of Bengal in late July and moved unusually far to the west. Because the rain clouds were within the moisture-laden storm from the east, they were able to pour abnormal amounts of rain on the barren mountainsides, which then ran into the Indus.

The progress of the storm system stood out in the satellite radar data, Houze said.

"We looked through 10 years of data from the satellite and we just never saw anything like this," he said. "The satellite only passes over the area a couple of times a day, but it just happened to see these systems at a time when they were well developed."

Houze is the lead author of a paper detailing the findings to be published in the *Bulletin of the American Meteorological Society*. Co-authors are Kristen Rasmussen, Socorro Medina and Stacy Brodzik of the UW and Ulrike Romatschke of the University of Vienna in Austria.

Houze also will discuss the findings during a session on Jan. 25 at the American Meteorological Society's annual meeting in Seattle.

The storms were associated with a wind pattern that could be traced in the satellite data back to its origin over the Bay of Bengal, Houze said. Finding the storm system's signature in the satellite data makes it possible to incorporate that information into weather forecast models. That could make it possible for meteorologists to forecast when conditions are favorable for such an event to occur again and provide a warning.

"I think this was a rare event, but it is one you want to be thinking about," Houze said. "Understanding what happened could lead to better predictions of such disasters in the future."

Story Source:

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

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http://www.sciencedaily.com/releases/2011/01/110125091826.htm

First Single-Fingered Dinosaur Discovered

Artist's impression of Linhenykus monodactylus. (Credit: © Julius T. Csotonyi)

ScienceDaily (Jan. 25, 2011) — A new species of parrot-sized dinosaur, the first discovered with only one finger, has been unearthed in Inner Mongolia, China.

Scientists named the new dinosaur *Linhenykus monodactylus*, after the nearby city of Linhe. The work was recently published online in *Proceedings of the National Academy of Sciences* (*PNAS*).

The new dinosaur belongs to the *Alvarezsauroidea*, a branch of the carnivorous dinosaur group Theropoda. Theropods gave rise to modern birds and include such famous dinosaurs as *Tyrannosaurus* and *Velociraptor*.

An international team of palaeontologists found the fossil preserved in rocks of the Upper Cretaceous Wulansuhai Formation, which is located near the border between Mongolia and China. The formation dates to 84-75 million years ago and has yielded a rich trove of vertebrate fossils including the recently discovered theropod *Linheraptor exquisitus*. The authors uncovered a partial skeleton from the site, which included bones of the vertebral column, the forelimb, a partial pelvis and nearly complete hind limbs.

Linhenykus most likely grew to a couple of feet tall and weighed only as much as a large parrot. The new theropod is unusual in having just one large claw, which may have been used to dig into insect nests, on each of its hands. This feature makes the specimen the only known dinosaur with one finger, and highlights the wide variety of evolutionary modifications of the hand that existed in different theropods.

Michael Pittman of the Department of Earth Sciences at University College London, co-author and discoverer of the specimen said: "Non-avian theropods start with five fingers but evolved to have only three fingers in later forms. Tyrannosaurs were unusual in having just two fingers but the one-fingered *Linhenykus* shows how extensive and complex theropod hand modifications really were."

Most theropod dinosaurs have three fingers on each hand, but in most alvarezsauroids other than *Linhenykus* the two outer fingers are reduced to tiny, apparently useless structures. The presence of only one finger in *Linhenykus*, which is hypothesized to be a relatively primitive alvarezsauroid, shows that these vestigial fingers were not present in all members of the group. The reasons for the loss of the two outer fingers in

Linhenykus are unclear, and their disappearance may simply reflect the fact that they were no longer being actively maintained by natural selection

Jonah Choiniere, co-author and co-discoverer of the specimen from the Division of Paleontology at the American Museum of Natural History said: "Vestigial structures, like legs in whales and snakes, may appear and disappear seemingly randomly in the course of evolution. *Linhenykus* highlights the vestigiality of the outer fingers of advanced alvarezsauroids and underscores the complexity in evolution of these vestigial fingers."

Linhenykus lived with closely-related and similarly-sized theropod dinosaurs, but the specializations of its skeleton may reflect differences in behaviour or foraging strategy. *Linhenykus* also lived alongside small mammals, lizards, clubbed dinosaurs (ankylosaurs) and horned dinosaurs (ceratopsians).

'The first known monodactyl non-avian dinosaur and the complex evolution of the alvarezsauroid hand' is published in *Proceedings of the National Academy of Sciences*.

Story Source:

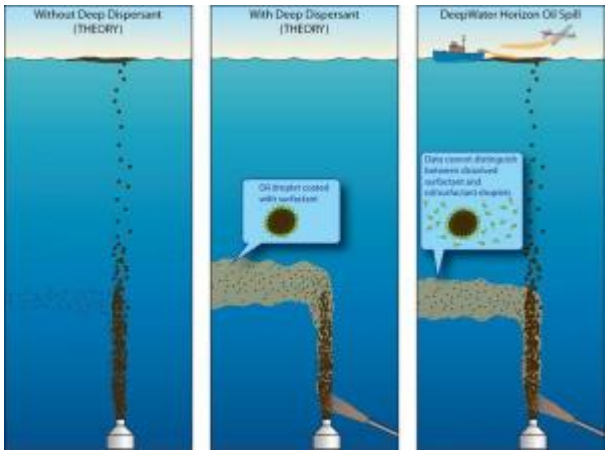
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University College London**.

Journal Reference:

1. Xing Xu, Corwin Sullivan, Michael Pittman, Jonah N. Choiniere, David Hone, Paul Upchurch, Qingwei Tan, Dong Xiao, Lin Tan, Fenglu Han. **A monodactyl nonavian dinosaur and the complex evolution of the alvarezsauroid hand**. *Proceedings of the National Academy of Sciences*, 2011; DOI: 10.1073/pnas.1011052108

http://www.sciencedaily.com/releases/2011/01/110124151717.htm

First Study of Dispersants in Gulf Spill Suggests a Prolonged Deepwater Fate



Breaking up is hard to do. When oil and gas mixtures are ejected from a deep wellhead, liquid oil droplets of many different sizes form and rise toward the ocean surface. Because the smaller droplets become as dense as the surrounding water deep below the surface--in this case at about 1,100 meters—they are swept away laterally by prevailing ocean currents (left panel). When a dispersant is added at the depth of the wellhead, a component called a surfactant breaks up the oil into small droplets (middle panel). If the dispersant works perfectly, virtually all the liquid oil is in these "neutrally buoyant" droplets and is carried away before ever reaching the surface and the droplets become small enough to be consumed, or "biodegraded," by bacteria. In the Deepwater Horizon spill (right panel), scientists found evidence that the dispersant mixed with the small droplets in the deep-water hydrocarbon plume but also discovered the oil/dispersant mix had not yet biodegraded several months after the spill. The study could not distinguish between oil droplets coated with surfactant (which would suggest the dispersant worked as planned) and surfactant floating freely on its own (suggesting the substance did not attach to the oil, as intended). (Credit: Jack Cook, Woods Hole Oceanographic Institution)

ScienceDaily (Jan. 26, 2011) — To combat last year's Deepwater Horizon oil spill, nearly 800,000 gallons of chemical dispersant were injected directly into the oil and gas flow coming out of the wellhead nearly one mile deep in the Gulf of Mexico. Now, as scientists begin to assess how well the strategy worked at breaking up oil droplets, Woods Hole Oceanographic Institution (WHOI) chemist Elizabeth B. Kujawinski and her colleagues report that a major component of the dispersant itself was contained within an oil-gas-laden plume in the deep ocean and had still not degraded some three months after it was applied.

While the results suggest the dispersant did mingle with the oil and gas flowing from the mile-deep wellhead, they also raise questions about what impact the deep-water residue of oil and dispersant -- which some say has its own toxic effects -- might have had on environment and marine life in the Gulf.

"This study gives our colleagues the first environmental data on the fate of dispersants in the spill," said Kujawinski, who led a team that also included scientists from UC Santa Barbara. "These data will form the basis of toxicity studies and modeling studies that can assess the efficacy and impact of the dispersants.

"We don't know if the dispersant broke up the oil," she added. "We found that it didn't go away, and that was somewhat surprising."

The study, which appears online Jan. 26 in the American Chemical Society (ACS) journal *Environmental Science &Technology*, is the first peer-reviewed research to be published on the dispersant applied to the Gulf spill and the first data in general on deep application of a dispersant, according to ACS and Kujawinski. Some

previous studies had indicated that dispersants applied to surface oil spills can help prevent surface slicks from endangering marshes and coastlines.

Kujawinski and her colleagues found one of the dispersant's key components, called DOSS (dioctyl sodium sulfosuccinate), was present in May and June -- in parts-per-million concentrations--in the plume from the spill more than 3,000 feet deep. The plume carried its mixture of oil, natural gas and dispersant in a southwest direction, and DOSS was detected there at lower (parts-per-billion) concentrations in September.

Using a new, highly sensitive chromatographic technique that she and WHOI colleague Melissa C. Kido Soule developed, Kujawinski reports those concentrations of DOSS indicate that little or no biodegradation of the dispersant substance had occurred. The deep-water levels suggested any decrease in the compound could be attributed to normal, predictable dilution. They found further evidence that the substance did not mix with the 1.4 million gallons of dispersant applied at the ocean surface and appeared to have become trapped in deepwater plumes of oil and natural gas reported previously by other WHOI scientists and members of this research team. The team also found a striking relationship between DOSS levels and levels of methane, which further supports their assertion that DOSS became trapped in the subsurface.

Though the study was not aimed at assessing the possible toxicity of the lingering mixture -- Kujawinski said she would "be hard pressed to say it was toxic" -- it nevertheless warrants toxicity studies into possible effects on corals and deep-water fish such as tuna, she said. The EPA and others have already begun or are planning such research, she added.

David Valentine of UC Santa Barbara and a co-investigator in the study, said, "This work provides a first glimpse at the fate and reactivity of chemical dispersants applied in the deep ocean. By knowing how the dispersant was distributed in the deep ocean, we can begin to assess the subsurface biological exposure, and ultimately what effects the dispersant might have had."

"The results indicate that an important component of the chemical dispersant injected into the oil in the deep ocean remained there, and resisted rapid biodegradation," said Valentine, whose team collected the samples for Kujawinski's laboratory analysis. "This knowledge will ultimately help us to understand the efficacy of the dispersant application, as well as the biological effects."

Kujawinski and Valentine were joined in the study by Soule and Krista Longnecker of WHOI, Angela K. Boysen a summer student at WHOI, and Molly C. Redmond of UC Santa Barbara. The work was funded by WHOI and the National Science Foundation. The instrumentation was funded by the National Science Foundation and the Gordon and Betty Moore Foundation.

In Kujawinski's technique, the target molecule was extracted from Gulf water samples with a cartridge that isolates the DOSS molecule. She and her colleagues then observed the molecule through a mass spectrometer, ultimately calculating its concentration levels in the oil and gas plume. This method is 1,000 times more sensitive than that used by the EPA and could be used to monitor this molecule for longer time periods over longer distances from the wellhead, she said.

"With this method, we were able to tell how much [dispersant] was there and where it went," Kujawinski said. She and her colleagues detected DOSS up to around 200 miles from the wellhead two to three months after the deep-water injection took place, indicating the mixture was not biodegrading rapidly.

"Over 290,000 kg, or 640,000 pounds, of DOSS was injected into the deep ocean from April to July," she said. "That's a staggering amount, especially when you consider that this compound comprises only 10% of the total dispersant that was added."

Kujawinski cautioned that "we can't be alarmist" about the possible implications of the lingering dispersant. Concentrations considered "toxic" are at least 1,000 times greater than those observed by Kujawinski and her colleagues, she said. But because relatively little is known about the potential effects of this type of dispersant/hydrocarbon combination in the deep ocean, she added, "We need toxicity studies."

"The decision to use chemical dispersants at the sea floor was a classic choice between bad and worse," Valentine said. "And while we have provided needed insight into the fate and transport of the dispersant we still don't know just how serious the threat is; the deep ocean is a sensitive ecosystem unaccustomed to chemical irruptions like this, and there is a lot we don't understand about this cold, dark world."

"The good news is that the dispersant stayed in the deep ocean after it was first applied," Kujawinski says. "The bad news is that it stayed in the deep ocean and did not degrade."

Story Source:

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

Journal Reference:

1. Elizabeth B. Kujawinski, Melissa C. Kido Soule, David L. Valentine, Angela K. Boysen, Krista Longnecker, Molly C. Redmond. **Fate of Dispersants Associated with the Deepwater Horizon Oil Spill**. *Environmental Science & Technology*, 2011; : 110126010225058 DOI: 10.1021/es103838p

http://www.sciencedaily.com/releases/2011/01/110126091437.htm

Centuries of Sailors Weren't Wrong: Looking at the Horizon Stabilizes Posture

ScienceDaily (Jan. 26, 2011) — Everybody who has been aboard a ship has heard the advice: if you feel unsteady, look at the horizon. For a study published in *Psychological Science*, a journal of the Association for Psychological Science, researchers measured how much people sway on land and at sea and found there's truth in that advice; people aboard a ship are steadier if they fix their eyes on the horizon.

Thomas A. Stoffregen of the University of Minnesota has been studying "body sway" for decades -- how much people rock back and forth in different situations, and what this has to do with motion sickness. In just a normal situation, standing still, people move back and forth by about four centimeters every 12 to 15 seconds. Stoffregen and his coauthors, Anthony M. Mayo and Michael G. Wade, wanted to know how this changes when you're standing on a ship.

To study posture at sea, Stoffregen made contact with the U.S. consortium that runs scientific research ships. "I'm really an oddball for these folks, because they're studying oceanography, like hydrothermal vents. Here's this behavioral scientist, calling them up," he says. He boards a ship when it is travelling between different projects -- for example, in this study, he rode on the research vessel Atlantis as it went between two points in the Gulf of California. "It had nothing to do with the fact that I like cruising near the tropics," he jokes. Since the ships are between scientific expeditions, he can sleep in one of the empty bunks normally reserved for ocean scientists, and crew members volunteer to take part in his study.

The study compared the same people standing on dry land -- a dock in Guaymas, Mexico -- and aboard the ship. In each experiment, the crew member stood comfortably on a force plate and focused on a target -- either something about 16 inches in front of them, or a far-off point; a distant mountain when standing on land or the horizon when standing on the ship. On land, people were steadier when they looked at the close-up target and swayed more when they looked far away. On the ship, however, they were steadier when they looked at the horizon.

This is actually counterintuitive, Stoffregen says. When you're standing on a ship, you need to adjust to the ship's movement, or you'll fall over. So why would it help to look at the horizon and orient yourself to the Earth? He thinks it may help stabilize your body by helping you differentiate between sources of movement -- the natural movement coming from your body and the movement caused by the ship.

Stoffregen thinks this motion of bodies may predict motion sickness. "It's the people who become wobbly who subsequently become motion sick," he says. He had originally hoped to study seasickness directly, but so far his subjects have all been seasoned crew members who are used to the ship's movement and don't get sick; his dream is to do his experiments aboard a ship full of undergraduate oceanography majors going to sea for the first time. "I'd give my right arm to get on one of those."

Story Source:

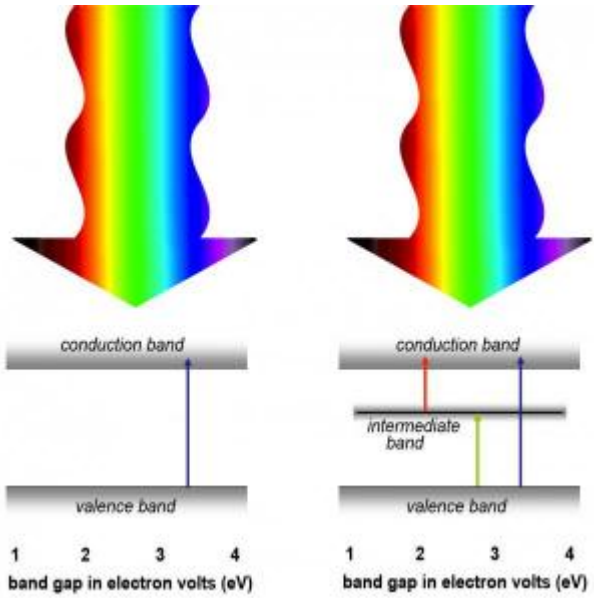
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Association for Psychological Science**.

Journal Reference:

1. A. M. Mayo, M. G. Wade, T. A. Stoffregen. **Postural Effects of the Horizon on Land and at Sea**. *Psychological Science*, 2010; 22 (1): 118 DOI: 10.1177/0956797610392927

http://www.sciencedaily.com/releases/2011/01/110126121736.htm

Practical Full-Spectrum Solar Cell Comes Closer



A solar cell's ability to convert sunlight to electric current is limited by the band gaps of the semiconductors from which it is made. For example, semiconductors with wide band gaps respond to shorter wavelengths with higher energies (lower left). A semiconductor with an intermediate band has multiple band gaps and can respond to a range of energies (lower right). (Credit: Image courtesy of DOE/Lawrence Berkeley National Laboratory)

ScienceDaily (Jan. 26, 2011) — Solar cells are made from semiconductors whose ability to respond to light is determined by their band gaps (energy gaps). Different colors have different energies, and no single semiconductor has a band gap that can respond to sunlight's full range, from low-energy infrared through visible light to high-energy ultraviolet.

Although full-spectrum solar cells have been made, none yet have been suitable for manufacture at a consumer-friendly price. Now Wladek Walukiewicz, who leads the Solar Energy Materials Research Group in the Materials Sciences Division (MSD) at the U.S. Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab), and his colleagues have demonstrated a solar cell that not only responds to virtually the entire solar spectrum, it can also readily be made using one of the semiconductor industry's most common manufacturing techniques.

The new design promises highly efficient solar cells that are practical to produce. The results are reported in a recent issue of *Physical Review Letters*.

How to make a full-spectrum solar cell

"Since no one material is sensitive to all wavelengths, the underlying principle of a successful full-spectrum solar cell is to combine different semiconductors with different energy gaps," says Walukiewicz.

One way to combine different band gaps is to stack layers of different semiconductors and wire them in series. This is the principle of current high-efficiency solar cell technology that uses three different semiconductor alloys with different energy gaps. In 2002, Walukiewicz and Kin Man Yu of Berkeley Lab's MSD found that by adjusting the amounts of indium and gallium in the same alloy, indium gallium nitride,

each different mixture in effect became a different kind of semiconductor that responded to different wavelengths. By stacking several of the crystalline layers, all closely matched but with different indium content, they made a photovoltaic device that was sensitive to the full solar spectrum.

However, says Walukiewicz, "Even when the different layers are well matched, these structures are still complex -- and so is the process of manufacturing them. Another way to make a full-spectrum cell is to make a single alloy with more than one band gap."

In 2004 Walukiewicz and Yu made an alloy of highly mismatched semiconductors based on a common alloy, zinc (plus manganese) and tellurium. By doping this alloy with oxygen, they added a third distinct energy band between the existing two -- thus creating three different band gaps that spanned the solar spectrum. Unfortunately, says Walukiewicz, "to manufacture this alloy is complex and time-consuming, and these solar cells are also expensive to produce in quantity."

The new solar cell material from Walukiewicz and Yu and their colleagues in Berkeley Lab's MSD and RoseStreet Labs Energy, working with Sumika Electronics Materials in Phoenix, Arizona, is another multiband semiconductor made from a highly mismatched alloy. In this case the alloy is gallium arsenide nitride, similar in composition to one of the most familiar semiconductors, gallium arsenide. By replacing some of the arsenic atoms with nitrogen, a third, intermediate energy band is created. The good news is that the alloy can be made by metalorganic chemical vapor deposition (MOCVD), one of the most common methods of fabricating compound semiconductors.

How band gaps work

Band gaps arise because semiconductors are insulators at a temperature of absolute zero but inch closer to conductivity as they warm up. To conduct electricity, some of the electrons normally bound to atoms (those in the valence band) must gain enough energy to flow freely -- that is, move into the conduction band. The band gap is the energy needed to do this.

When an electron moves into the conduction band it leaves behind a "hole" in the valence band, which also carries charge, just as the electrons in the conduction band; holes are positive instead of negative.

A large band gap means high energy, and thus a wide-band-gap material responds only to the more energetic segments of the solar spectrum, such as ultraviolet light. By introducing a third band, intermediate between the valence band and the conduction band, the same basic semiconductor can respond to lower and middle-energy wavelengths as well.

This is because, in a multiband semiconductor, there is a narrow band gap that responds to low energies between the valence band and the intermediate band. Between the intermediate band and the conduction band is another relatively narrow band gap, one that responds to intermediate energies. And finally, the original wide band gap is still there to take care of high energies.

"The major issue in creating a full-spectrum solar cell is finding the right material," says Kin Man Yu. "The challenge is to balance the proper composition with the proper doping."

In solar cells made of some highly mismatched alloys, a third band of electronic states can be created inside the band gap of the host material by replacing atoms of one component with a small amount of oxygen or nitrogen. In so -- called II-VI semiconductors (which combine elements from these two groups of Mendeleev's original periodic table), replacing some group VI atoms with oxygen produces an intermediate band whose width and location can be controlled by varying the amount of oxygen. Walukiewicz and Yu's original multiband solar cell was a II-VI compound that replaced group VI tellurium atoms with oxygen

atoms. Their current solar cell material is a III-V alloy. The intermediate third band is made by replacing some of the group V component's atoms -- arsenic, in this case -- with nitrogen atoms.

Finding the right combination of alloys, and determining the right doping levels to put an intermediate band right where it's needed, is mostly based on theory, using the band anticrossing model developed at Berkeley Lab over the past 10 years.

"We knew that two-percent nitrogen ought to do the job," says Yu. "We knew where the intermediate band ought to be and what to expect. The challenge was designing the actual device."

Passing the test

Using their new multiband material as the core of a test cell, the researchers illuminated it with the full spectrum of sunlight to measure how much current was produced by different colors of light. The key to making a multiband cell work is to make sure the intermediate band is isolated from the contacts where current is collected.

"The intermediate band must absorb light, but it acts only as a stepping stone and must not be allowed to conduct charge, or else it basically shorts out the device," Walukiewicz explains.

The test device had negatively doped semiconductor contacts on the substrate to collect electrons from the conduction band, and positively doped semiconductor contacts on the surface to collect holes from the valence band. Current from the intermediate band was blocked by additional layers on top and bottom.

For comparison purposes, the researchers built a cell that was almost identical but not blocked at the bottom, allowing current to flow directly from the intermediate band to the substrate.

The results of the test showed that light penetrating the blocked device efficiently yielded current from all three energy bands -- valence to intermediate, intermediate to conduction, and valence to conduction -- and responded strongly to all parts of the spectrum, from infrared with an energy of about 1.1 electron volts (1.1 eV), to over 3.2 eV, well into the ultraviolet.

By comparison, the *un*blocked device responded well only in the near infrared, declining sharply in the visible part of the spectrum and missing the highest-energy sunlight. Because it was unblocked, the intermediate band had essentially usurped the conduction band, intercepting low-energy electrons from the valence band and shuttling them directly to the contact layer.

Further support for the success of the multiband device and its method of operation came from tests "in reverse" -- operating the device as a light emitting diode (LED). At low voltage, the device emitted four peaks in the infrared and visible light regions of the spectrum. Primarily intended as a solar cell material, this performance as an LED may suggest additional possibilities for gallium arsenide nitride, since it is a dilute nitride very similar to the dilute nitride, indium gallium arsenide nitride, used in commercial "vertical cavity surface-emitting lasers" (VCSELs), which have found wide use because of their many advantages over other semiconductor lasers.

With the new, multiband photovoltaic device based on gallium arsenide nitride, the research team has demonstrated a simple solar cell that responds to virtually the entire solar spectrum -- and can readily be made using one of the semiconductor industry's most common manufacturing techniques. The results promise highly efficient solar cells that are practical to produce.

Story Source:

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

Journal Reference:

1. N. López, L. Reichertz, K. Yu, K. Campman, W. Walukiewicz. **Engineering the Electronic Band Structure for Multiband Solar Cells**. *Physical Review Letters*, 2011; 106 (2) DOI: 10.1103/PhysRevLett.106.028701

http://www.sciencedaily.com/releases/2011/01/110125141810.htm

Genetic Origin of Cultivated Citrus Determined: Researchers Find Evidence of Origins of Orange, Lime, Lemon, Grapefruit, Other Citrus Species

Researchers in China have discovered the genetic origins of citrus, including bergamot (pictured). (Credit: Photo by Xiaomeng Li)

ScienceDaily (Jan. 16, 2011) — Citrus species are among the most important fruit trees in the world. Citrus has a long history of cultivation, often thought to be more than 4,000 years. Until now, however, the exact genetic origins of cultivated citrus such as sweet orange (*Citrus sinensis*), lemon (*C. limon*), and grapefruit (*C. paradisi*) have been a mystery. A team of researchers from China has published a study in the *Journal of the American Society of Horticultural Science* that provides genetic evidence of the origins of a variety species of today's cultivated citrus.

The research team, led by Zhiqin Zhou from Southwest University, analyzed amplified fragment length polymorphism (AFLP) fingerprints -- a technique that has been used successfully to assess the origin of potato cultivars -- with chloroplast DNA (cpDNA) sequence analysis and nuclear internal transcribed spacer. "The combination of nuclear DNA and cpDNA data allowed us to identify the exact genetic origin of the cultivated citrus," they wrote.

The results proved that bergamot and lemon were derived from citron and sour orange, and grapefruit was a hybrid that originated from a cross between pummelo and sweet orange. The data demonstrated that sweet orange and sour orange were hybrids of mandarin and pummelo, while rough lemon was a cross between citron and mandarin. The evidence also confirmed that bergamot was a hybrid of sour orange and citron, with sour orange as the maternal parent and citron as the paternal parent.

"Our molecular evidence presented more convincing data than all other previous studies in supporting the origin of lime," noted the scientists. The data confirmed a species of Papeda to be the female parent and C. medica as the male for mexican lime.

The researchers said that a clear understanding of the citrus genetic background is necessary for better characterization and utilization of citrus germplasm, adding that this research will provide important new information for future study on the genetics and breeding of citrus.

Story Source:

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

Journal Reference:

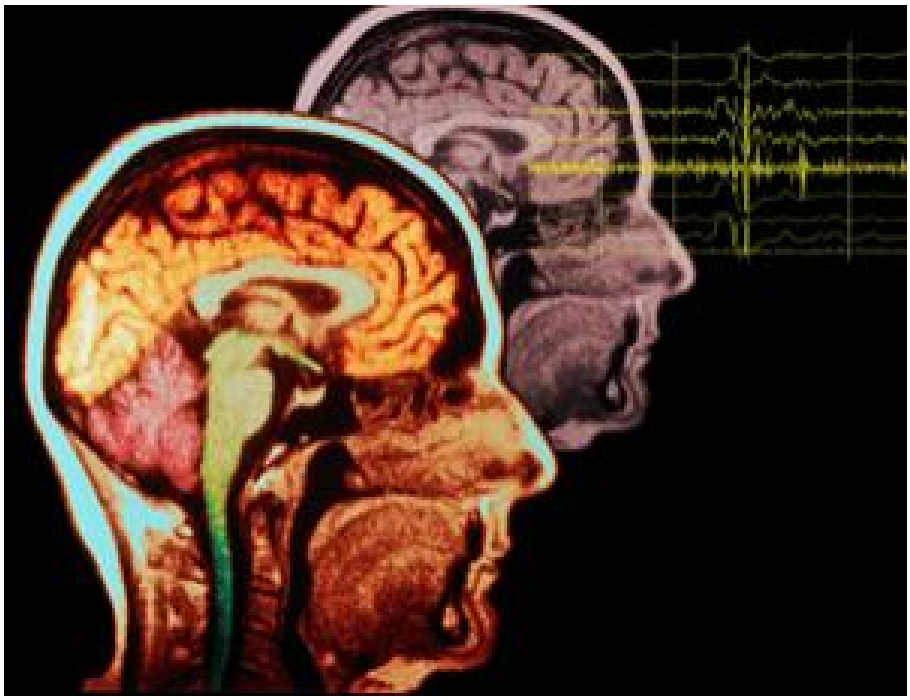
1. Xiaomeng Li, Rangjin Xie, Zhenhua Lu, and Zhiqin Zhou. **The Origin of Cultivated Citrus as Inferred from Internal Transcribed Spacer and Chloroplast DNA Sequence and Amplified Fragment Length Polymorphism Fingerprints**. *Journal of the American Society for Horticultural Science*, 2010; 135: 341-350 [link]

http://www.sciencedaily.com/releases/2011/01/110118101600.htm

World's first brain scanner made for two

- 27 January 2011 by **Ferris Jabr**

Magazine issue 2797.



Two heads better (Image: Phanie/Rex Features)

TWO heads are better than one - particularly if you're studying the brain activity underlying social interaction. The problem is that imaging technologies such as MRI have only been able to handle one brain at a time - until now. Ray Lee at Princeton University has developed the world's first dual-headed fMRI scanner. The innovation allows the simultaneous imaging of the brain activity of two people lying in the same scanner.

Usually, a lone person lies inside a scanner's narrow tunnel, cocooned by powerful magnets and radio-frequency coils which detect how hydrogen atoms in the body respond to magnetic fields, or how the flow of oxygenated blood changes as a result of brain activity. Although it is possible to squeeze two adults into most MRI machines - Willibrord Weijmar Schultz at the University of Groningen in the Netherlands famously scanned the bodies of couples as they copulated inside an MRI - attempting to scan both their brains at once would produce too fuzzy an image.

So Lee designed a pair of coils that fits into a scanner, providing two distinct loops in which to place each participant's head (see picture). He also fitted a window between the coils so participants can see one another. "This opens up a new area of MRI," says Lucien Levy, head of neuro-radiology at George Washington University Medical Center in Washington DC. "I haven't seen anything like this."

To test the scanner, Lee asked couples to lie facing one another and blink in unison. Brain activity in the fusiform gyrus - involved in facial recognition - was tightly correlated. Lee also asked couples to repeatedly embrace and release one another, and observed similarly synchronised brain activity. He announced his results in November 2010 at the Society for Neuroscience conference in San Diego, California.

"In close proximity, people tend to mimic each other in all kinds of ways, especially through non-verbal signals," says Marco Iacoboni at the University of California, Los Angeles. "Now we can examine brain activity of an intimate pair copying each other in real time. That hasn't been done before."

James Coan at the University of Virginia in Charlottesville is also eager to test the device: "People distribute neural processing across multiple brains when solving problems," he says. "You essentially contract out part of a given problem to someone else's mind. Lee's work would give us the opportunity to see two brains reacting to a problem simultaneously."

Jesse Rissman at Stanford University in California says it remains unclear just how advantageous scanning people in the same machine will be compared with scanning people in different machines who are linked by video. He points out that if people move around too much inside a scanner, they disrupt the signal, so interactions may be limited to small gestures.

But Coan stresses the potency of even minor actions: "Couples could hold each other or rub each other's back," he says, "and simply having another human face inches from their own is a very powerful stimulus. With a little creativity, the sky's the limit for figuring out how brains respond to each other."

http://www.newscientist.com/article/mg20927973.700-worlds-first-brain-scanner-made-for-two.html