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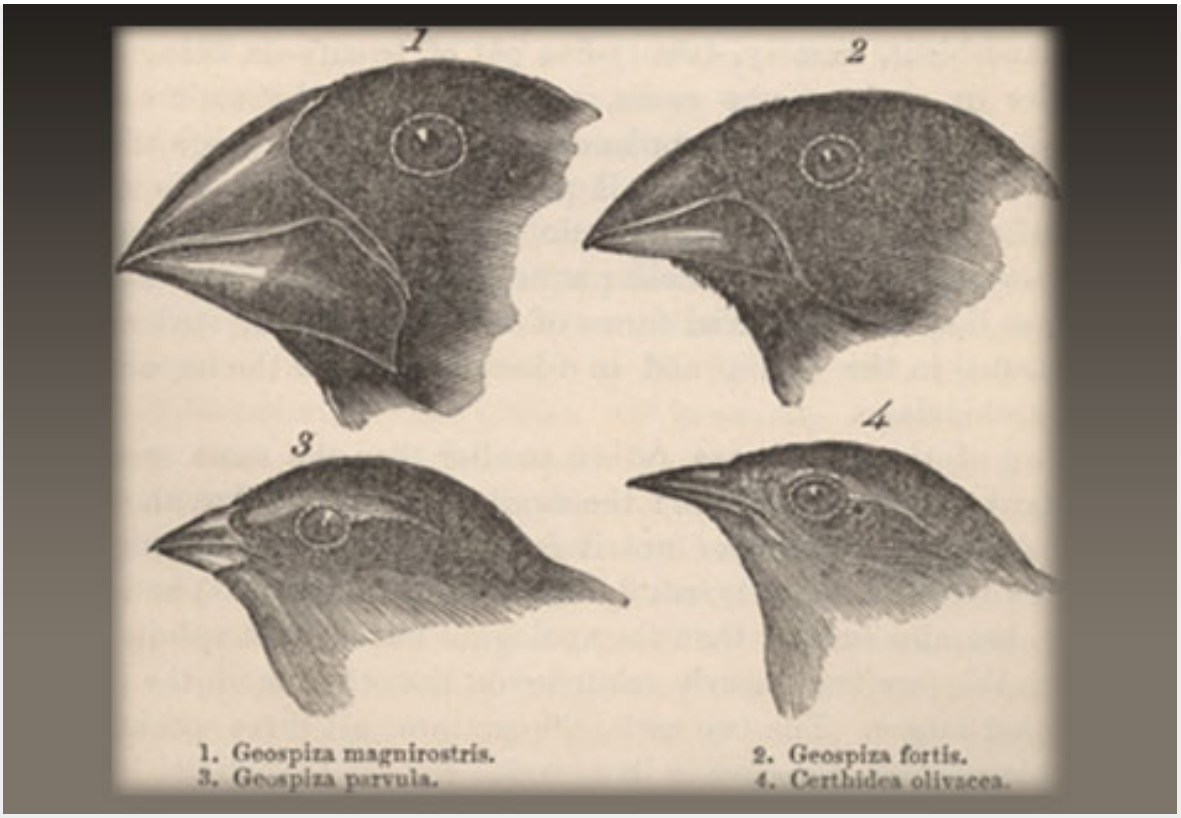
CONTENTS

Scientists Take Charles Darwin on the Road

A posse of evolutionary scientists traveled to the heart of America to share their excitement about science on the birthday of Charles Darwin. This is their story.

By Craig McClain



Pictured, Charles Darwin's famous finches. A team of stalwart scientists fanned out across the country to participate in the Darwin Day Road Show, offering them an opportunity to share their excitement about science to students and faculty around the country. (Wikipedia.org).

"I want to send our scientists to rural schools and communities around the U.S. to talk about evolution for Darwin Day 2011." Jory Weintraub's words hung undigested in the silent air of the management meeting at our North Carolina center last July.

"You want to send our scientists where?" I jested. "On purpose?"

In my two years overseeing the daily operations of the science group at the National Evolutionary Synthesis Center, or NESCent, I have come to expect inventive programs from Weintraub, my counterpart in our education and outreach group. Core to our mission is innovation, a challenge we were tasked with by the National Science Foundation when they created the center to promote the synthesis of information and concepts on outstanding questions in evolutionary science.

Craig McClain speaks to students in the Perkins High School gym in Grant, Neb. (Craig McClain)

This time, however, his idea caught me somewhat off guard. And yet, a half year later, I found myself in rural Nebraska alongside Gregor Yanega, a NESCent biologist who works on hummingbird evolution. The temperature is 10 degrees Fahrenheit, and we, Team Nebraska, were not quite sure what to expect.

On our way to Nebraska, Yanega and I bumped into a scientific colleague at Chicago's O'Hare Airport. When we spoke of our Darwin Day activities, he responded with similar bemusement, a cocked eyebrow, and a variation of my original question to Weintraub. From scientific colleagues to my family in rural Arkansas, the general response fell between incredulity and curiosity.

This is because all of us know that despite no shortage of evidence of evolution in the world around us, the concept remains controversial. Just under half of Americans believe the theory of evolution is not supported by any confirmed facts. A recent poll found that 42 percent of the public also believes the theory of evolution conflicts with their religious views. A new study also suggests that many public high school biology teachers may be overly cautious in advocating for evolutionary biology in the classroom. Their caution arises because they do not feel they understand it well enough to teach it properly, or they are trying to avoid a controversial topic, or in some cases because they do not "believe" in evolution themselves.

The discord goes beyond just evolution and extends to science as a whole. Even some political movements are now setting anti-science agendas. So perhaps unsurprisingly, Darwin Day celebrations often only occur at universities, museums, science centers and other s

afe havens. In rural American primary schools, and even urban schools, the concept of the Darwin Day Road Show, as we came to call our program, was unprecedented. Dramatic as it sounds, it was, and is, an experiment with risks for the superintendents, principals and teachers who invited us into their schools and for the scientists who ventured into the unknown.

Despite these reasons explaining why a cautious evolutionary biologist would not want to venture into the heartland of America when called upon, NESCent scientists overwhelmingly volunteered to participate and share their research. Being from a rural Arkansas town, I jumped at the opportunity to participate and convey my passion about science and evolutionary biology to an audience often not exposed to it. Honestly, how often does a marine biologist from a landlocked Southern state have the chance to visit Western Nebraska and talk about the thing he loves?

Other NESCent scientists brought additional motivations. Jenny McGuire, who examines the evolution of fossil mammals, visited a Virginia county school just 15 miles from her own hometown. “I saw it as a fun

A church along on highway 61 near Grant, Neb. (Craig McClain)

homecoming, a chance to inform the public about science and how to be good scientific citizens.” Another member of Team Virginia, Jennifer Verdolin, who studies the evolution of communication and sociality in prairie dogs, volunteered because it was “outside of the bounds of what we typically do for science outreach.”

A third team — John Logsdon, a biology professor at the University of Iowa and former NESCent sabbatical fellow with expertise on the evolution of sex, and Julie Meachen, a NESCent fellow examining the evolution of large carnivores like the saber-tooth cat — represented Team Iowa.

We received nearly two dozen invitations from educators within small schools and communities. We selected participants who would not otherwise have access to Darwin Day activities and would allow us the opportunity to speak candidly with students and public alike. Ultimately, the teachers of each participating school held the key to the project’s success: They laid the groundwork and ensured these exchanges were instructive and positive events.

NESCent worked hard in advance to ensure the success of our visits. In January, all the Road Show teams participated in a workshop and role-playing led by Josh Rosenau of the National Center for Science Education to prepare for the questions we might field during our visits. While we may excel in our respective areas of evolutionary biology, many of us had never immersed ourselves in the culture wars that surround the field. In breakout groups, we wrote our hopes and fears for the experiment.

The city of Grant, Neb., where one of the Darwin Day presentations took place. (Craig McClain)

Our hopes? We wanted to convey the excitement and relevance of science, that scientists are part of the general public (you may even see us shopping at the grocery store) and to begin building a community of support for science. Our fears? We worried about being patronizing, being able to communicate effectively, not having answers and becoming caught up in contentious interactions. I later realized this training was only necessary to relieve our own apprehension.

As Gregor Yanega and I drove past a sign listing state championships of the Perkins County High School Plainsmen in Nebraska and into the small town of Grant, population around a thousand, I begin to feel anxious. Despite the phone calls and assurances, I still wondered how we would be received.

Perkins County High School proceeded cautiously as well, with emails and phone calls between NESCent and school officials instilling confidence on both sides. The principal wanted assurances that we were not pursuing any atheist — or any religious — agenda. We assured him that we did not want to broach these subjects any more than they wanted us to. Once we conveyed to teachers and administrators that our only goals were to discuss our research and talk about careers in science, much of the problems dissolved. We only wanted to excite others about the science that excites us.

The day before we rolled into Grant, Yanega and I visited the University of Nebraska at Kearney, where we met with undergraduates and lectured to both university and public audiences. We were met with enthusiasm and warmth, but admittedly, a university town, even in rural Nebraska, is far from foreign soil. The next morning at Perkins County High, we were welcomed by Scott King, our host teacher and by the combined smell of floor wax, wood and cafeteria food that characterizes any American school. Moments later, and center court, Yanega and I were talking about evolution in squids and birds in the high school gym.

As the day unfolded, Yanega and I were overwhelmed with the graciousness, enthusiasm and sincerity of the teachers, school administration and particularly the students that hosted us.

Gregor Yanega, in the blue shirt, on the flight from Colorado to Nebraska. (Craig McClain)

Over the course of our visits, the questions we received from students were thoughtful and founded in sheer curiosity about the science we presented. Indeed, the questions were the most exciting part of our collective visits. After I spoke about why giant squid are giant and the evolution of body size, a student asked, "Who would win between a giant squid and Chuck Norris?" Answer: "It depends on whether they were fighting on land or water."

In response to Jenny McGuire's talk about the rise of mammals, a student asked, "Why didn't dinosaurs make a comeback?" McGuire was asked a variant of this question, "Why didn't mammals also go extinct when dinosaurs did?" a few days later by a prominent university dean of sciences. Our visits served to remind us all that children, and even adults, are naturally and enthusiastically curious about the world around them.

Ours was not the only warm reception; other Road Show teams at Dan River Senior High School in Virginia and Muscatine High School in Iowa experienced the same. Indeed, at times we felt like rock stars! It is a rare and gratifying day in the life of any scientist when sixth-graders in Montana want your autograph. An Iowa student commented on a blog: "I really appreciated them taking time out of their day and week to come to our high school especially when we aren't a well-known or famous school." I often asked myself the reverse question when I entered a school. "Why would this school open its doors to me?"

When I asked all the Road Show scientists if they would participate again next year, without hesitation I received responses of "yes," "definitely" and "absolutely." Why? Because for all of us the Darwin Day Road Show was a gratifying adventure that no one will forget. From the landscapes with their silos, combines, center pivot crop circles, high school gymnasiums, to the indelible interactions we had along the way, we absorbed it all.

Joshua Hanna, our teacher from Iowa, emailed us: "I just wanted to share with you how amazing the whole experience was. It was INCREDIBLE! The event was well attended and the students had a blast picking John [Logsdon] and Julie [Meachen's] brains."

Jory Weintraub's bigger picture was to send teams out to share our enthusiasm for evolutionary science, introduce people to the diverse types of research we do and open students' minds to the possibilities of careers in science. All of us found our interactions on these topics engaging, rewarding and important. "I actually wish I would have more interactions with students," Jenny McGuire said after returning from Virginia.

Gregor Yanega partakes of some of the high school cuisine. (Craig McClain)

NESCent's goal was not only to talk about evolutionary biology on Darwin's birthday but also to offer an alternative to stereotypes of science and scientists in general. As Jennifer Verdolin stated, "We may be the only people they know doing anything like this." Near the end of our visit to Perkins County High School, a 10th-grader told us, "You guys are not what I expected from scientists. You're more normal." After Verdolin's talk on barking in prairie dogs to inform other prairie dogs about food location, a student in good fun began to yell "Cake, Cake!" to alert other students about the cutting of the birthday cake for Darwin.

Although I returned from my 5,600-mile, two-state whistle-stop tour physically and mentally bushed, I also returned to North Carolina invigorated.

Were there glitches? Yes, but none so large as to overshadow the positives of this experiment.

Take my wild-card experience. Four days in, I proceeded on to Montana near the Canadian border arriving near midnight sans luggage. The superintendent of this school had dealt with both local and national attention the previous semester when a student faced expulsion after accidentally bringing a rifle (used the previous weekend for hunting) to school in her car trunk. Understandably, the superintendent originally shied away from the potential of creating more disruption. It was just two weeks before my arrival that the host teacher convinced the principal to allow me to speak with her sixth-grade classes. Ultimately, the administration and teacher should be commended for allowing this. Indeed, while administrative officials and teachers proceeded cautiously, their foresight and willingness to engage with NESCent fostered the spirit of communication and dialogue.

Will there be a Darwin Day Road Show 2012?

"There is already talk of planning something for Darwin Day next year, and I think this would have been unlikely without the Road Show visit this year," said Dawn Simon, our host at the University of Nebraska at Kearney. "I don't think it is an exaggeration to say that for some students, it may have been a life-altering experience."

Gregor Yanega prepares for his lecture at the University of Nebraska Kearney. The room only has one audience member when this was taken, but 15 minutes later, it was packed. (Craig McClain)

Scott King emailed me from Nebraska a few days after my and Yanega's visit, "Almost every day since you were here, I have heard students, parents and teachers talking about the presentation. Everyone has had good things to say, and I have yet to hear anything negative about the entire event. It was a major hit with my students, and they have asked if you will be coming back next year. I even had a student approach me yesterday asking me details about marine biology as a future career opportunity."

So yes, with these invitations and our combined triumphs, there will be a Darwin Day Road Show 2012. In fact, NESCent plans for all 50 states by 2015.

Some criticize the Darwin Day Road Show for being nothing more than a "Darwinist ministry," others for it not being more explicit in its discussion of evolution and Darwin. I consider this a win. It means we have found a middle ground that allows scientists to stop communicating at and start communicating with the public. In the words of my colleague Kevin Zelnio, "If people are not part of the conversation, they are not invested in the discussion."

As I waited to depart Nebraska for Montana, I had hours to kill. I found myself in an outdoor sporting goods store searching for warmer socks. The young woman at the check-out asked if I am the "Giant Squid Guy" from the lecture two nights ago. My "yes" launched us into a dialogue that affirmed for me that our engagement, however brief, left a positive impression, one that could last a lifetime. Perhaps through the Darwin Day Road Show, we have gained some new participants in the conversation and inspired some future colleagues. And perhaps, it reminds us all that interactions between science and society need not be contentious. At its heart, science is about questions, and we all naturally ask them.

http://www.miller-mccune.com/science/scientists-take-charles-darwin-on-the-road-31211/

New Life for Crematories' Waste Heat

The idea of capturing waste heat for other purposes is well known and very green, but what about when the waste heat is derived from burning the dead?

By Justin Nobel

Is this a new source of energy? Some experts in Europe suggest that capturing waste heat derived from crematories and harnessing it rather than letting it out into the atmosphere is something that should be considered. (Henry Mühlpfordt / flickr.com)

Imagine a swimming pool heated by your dead grandmother. The town council in Redditch, England, recently approved a plan that will make this possible. Waste heat from a local crematory will heat water that will be piped to a nearby recreation center and used to heat the facility and its pool, saving about $23,000 a year in heating costs.

The idea has some asking if the process honors the dead or exploits them. "Some grieving families like the idea of their loved ones 'giving back something,'" John Troyer, deputy director of the Centre for Death and Society at the University of Bath, told the *Guardian* newspaper last month. "I see that becoming predominant, and this research as an opportunity to do something innovative and respectful to the funeral mourning process." Troyer, whose career has been spent looking the intersection of death and culture, is the lead author of a paper exploring crematoria heat capture.

"We are aware that it's controversial, but the people who oppose this don't understand exactly what we're doing," said Ceridwen John, the Redditch Borough Council's climate change manager. "People are dying anyway, and many choose to be cremated. Our options are to expel the waste heat into the atmosphere or to do something useful with it."

Redditch is acting in response to recent European Union legislation that requires crematories to reduce mercury emissions by 50 percent by 2013. Mercury is in dental amalgam fillings, which millions of people have. Upon cremation this mercury is volatilized and released into the atmosphere with the flue gas, where it can pollute lakes and accumulate in animals, like eagles and fish. Extracting the mercury requires cooling flue gas from 800 degrees Centigrade to 150 degrees; this waste heat is then pumped through a heat exchanger, a network of parallel pipes that allows two fluids, in this case flue gas and water, to transfer heat without contacting one another.

As flue gas cools, the water warms. Industrial facilities that generate a great deal of heat, like petrochemical plants or incinerators have long used heat exchangers to conserve energy, but the practice is just beginning to blossom in crematories.

"Recapturing energy is not rocket science, but you need to have a use for that energy," said Paul Rahill, the environmental and technical adviser for the Cremation Association of North America and president of the cremation division of Matthews International.

His team is working on several crematory heat recovery projects in Europe. In Stockholm, they will use the water heated by crematory waste heat to warm cemetery roads in winter, melting snow and saving salt. In summer, the hot water will be put through an absorption chiller, generating cold air for general air conditioning and the freezer rooms where bodies are kept before cremation. In the United States, the company is working on a way to transform crematory waste heat into electrical energy that can be put back on the grid, a technology they hope to have operable within the next few years.

But as of now, U.S. crematories don't utilize waste heat. For one, crematories in Europe are larger, performing on average about 1,100 cremations a year, verse 400 in the U.S., making energy recovery projects there more feasible. Amalgam fillings are also more popular in Europe, helping to inspire the mercury emissions laws that have promoted crematory heat recovery projects. (While the U.S. currently has no law restricting crematory mercury emissions, cremations are on the rise, making some health officials think we need one.)

But there is another reason; Europe is simply ahead of the U.S. on urban energy conservation.

"I don't think we have been good systematic thinkers," said Paul Mankiewicz, who directs The Gaia Institute, a New York City-based organization that aims to better integrate human communities and natural systems. "We have moved industry away from urban centers, which is problematic. If you don't connect the flow of waste materials to the flow of production, you're missing the boat."

In New York City's Bronx neighborhood, Gaia has generated a space for water capture storage in sidewalk tree planters by using glass bits recycled from the city's waste stream and processed at a nearby plant. Another project involves mixing shredded Styrofoam coated with organic pectin and a compost made from discarded pumpkins and Christmas trees to create "GaiaSoil," which weighs one-fourth as much as silica-rich regular soil, making it advantageous for green roofs.

Will crematory-heated pools ever become popular in the U.S.? Mankiewicz is matter of fact: "I am sure the idea of having a dead body so close to water would be a problem for some people," he said. "But if you breathe air, you're breathing air breathed by someone who is now dead."

http://www.miller-mccune.com/environment/new-life-for-crematories-waste-heat-31501/

Crazy Weather and Climate: Do Dots Connect?

In an interview with Miller-McCune.com, meteorologist Kevin Trenberth examines the world's recently wacky weather and whether it's a sign of climate change or just routine variability.

By Bruce Dorminey

Australia's recent flooding can be seen in this NASA image. IPCC meteorologist Kevin Trenberth answers questions about the world's recently wacky weather and its connection to climate change. (NASA Goddard Photo)

At the end of one of the Northern Hemisphere's wildest winters in memory, we thought it would be a good time to ask a climatologist what's up with such extreme weather. Even Australia's normally calm summer has been anything but: First there was drought, then typhoons and then floods of biblical proportions.

Granted, such extreme weather has been exacerbated both by recent El Niños (warmer-than-normal sea surface temperatures) and La Niñas (colder-than-normal sea surface temperatures) in the equatorial Pacific. But it does give pause to wonder: Is this global warming on steroids, or are we merely seeing natural cyclical weather variations?

For answers, we turned to Kevin Trenberth, head of the Climate Analysis Section at the National Center for Atmospheric Research in Boulder, Colo. The climatologist, a leading member on the Intergovernmental Panel on Climate Change, shared the Nobel Peace Prize in 2007 when it was awarded to the IPCC.

He recently addressed this strange weather in a question-and-answer session with Miller-McCune.com.

Miller-McCune: What's causing the sudden winter weather extremes we've seen both here in the U.S. and in northern Europe over the last two winters, as well as in Australia?

Kevin Trenberth: Natural variability plays a major role along with human-induced climate change. There have been strong El Niño to La Niña transitions and natural modes of variability, such as the North Atlantic Oscillation, that have played major roles. During the latter part of El Niño and the following five months, heat comes out of the ocean and contributes to warming and is working in the same direction as global warming from humans. The result has been record-breaking sea surface temperatures and thus moisture in the atmosphere.

M-M: Is this related to a more southerly trajectory of the Northern Hemisphere's jetstream?

KT: That's correct. It is related to the negative phase of the NAO, which allows cold polar outbreaks to occur more readily. The NAO largely varies through natural processes on weekly, monthly or even longer timescales.

M-M: Does this negative phase of the NAO allow colder air to come to more southerly latitudes?

KT: In the negative phase, the westerlies [anti-trade winds] across the North Atlantic are weaker than normal and the cold air over the Arctic can flow more readily into lower latitudes and vice versa. In particular, there are often cold outbreaks over Europe with high temperatures over northeastern Canada and Greenland. That was the case in early January.

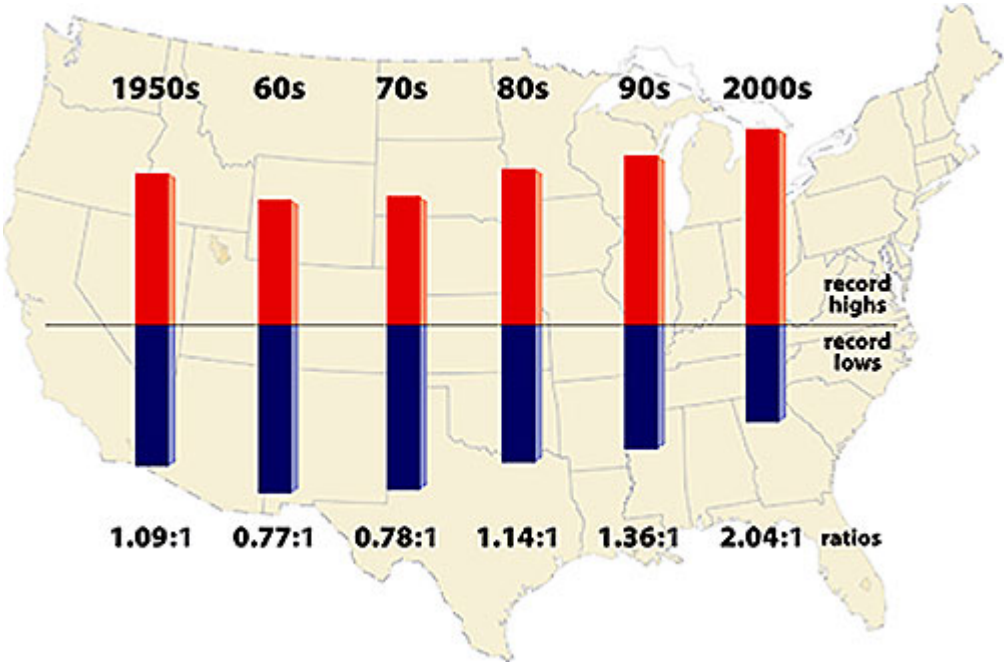
M-M: What's causing the NAO's negative phase?

KT: That's largely a natural variability, relating to interactions between individual storms and the overall westerlies in the atmosphere. There is a region of stronger westerlies in the positive in the NAO's positive phase and weaker westerlies in the NAO's negative phase.

M-M: Does climate change or global warming exacerbate these NAOs?

KT: That's a $64,000 question. In general, under global climate change, it's suspected that the NAO becomes a little more positive. But in the last two years, it's become quite negative, and so the speculation is about whether the negative phase is in any way related to the decrease in Arctic sea ice.

M-M: Are these current weather events anomalous?



Temperature gradients for the U.S. over the last 50 years. By the first decade of the 21st century, record-breaking hot temperatures were running at more than a 2-to-1 ratio to record-breaking cold temperatures. (Meehl et al 2009; National Center for Atmospheric Research)

KT: One measure of how anomalous things are is whether you're breaking records. There have been more record-breaking events than expected. In the U.S., for instance, the number of high temperature events has more than doubled [in the first decade of the 21st century]. What's happened is that the ratio of record-breaking hot events to cold events is about 2 to 1.

M-M: At what point would you be concerned about the freak weather signaling something truly deleterious about our climate?

KT: I already am. Natural variability is going on all the time and the biggest effects are from the El Niño. Between May 2009 and May 2010, we had quite a strong El Niño. When the mini-global warming from El Niño is added on, we really start to break records when the heat starts coming out of the ocean, as in July of last year. There was record-breaking flooding in China and India and then in August in Pakistan. Last September was the wettest on record in Australia. Then there was record-breaking flooding in Queensland, Australia, from December 2010 into January 2011. Those events were associated with quite high sea surface temperatures in the Indian Ocean and were partly a consequence of the El Niño and the change in ocean circulation. The residual effects of the El Niño meant there was extra evaporation and extra moisture available for the monsoons — first in Asia and subsequently in Australia.

M-M: Have these El Niños become more pronounced due to global warming?

KT: We have records of El Niño going back some 150 years, and there was a change in how it evolved starting somewhere around 1976. Today, the impacts of El Niño due to the floods and droughts around the world are certainly bigger. So while there are floods in South Asia and Australia, there are droughts in Africa and Peru and Equador. During El Niño, it tends to be wetter across the southern U.S. and drier in the north.

M-M: So, climate change really manifests itself with more weather extremes?

KT: Because water vapor in the atmosphere acts as a fuel for weather systems, the weather systems can get stronger. We can get heavier rains out of it. The two-day rains last May in Nashville, Tenn., were astounding. As for snow, if it's a bit warmer but still below freezing, you can actually get more snow, as with some of the East Coast snow storms. Because there's more moisture in the atmosphere, it gets dumped down in the form of snow instead of rain.

M-M: And you're saying there's more moisture in the air because globally the air is warmer?

KT: That's correct — in particular over the oceans. The main hydrological source of moisture is the oceans. The fact that sea temperatures are half to one degree centigrade above what they were 30 years ago is enough to bolster the snow amounts by at least 10 percent, if not more.

M-M: Are you at all wary of interpreting extreme weather events as evidence for longer-term climate change?

KT: Yes, but it is the main way climate change is expressed.

M-M: How effective is comparative paleo-climatology, in other words, the study of ice cores and historical records, in helping your group understand the current climate?

KT: It helps, but the paleo data have large uncertainties and require careful interpretation. There's an infinite variety in weather, and some of it occurs on relatively long timescales. The thing that is most clear is the increasing temperatures. Along with that, there's more water vapor in the atmosphere. Beyond that, we can look to sea levels rising, Arctic sea ice and glaciers melting. All this is consistent with this warming. There's also pretty good evidence that when it rains, it rains harder than it used to especially across the U.S. That's due to anthropogenic climate change, and that's only going to get bigger.

M-M: Is the climate definitely changing?

KT: The climate is continuing to change. One way change is manifested is through these extreme events. These are the ones that impact ecosystems and society. But because they are extreme, they are relatively rare and statistics on them are not good, but they are consistent with climate change. Because of that warming, there's more water vapor in the atmosphere.

M-M: What's needed in terms of resources or technology to improve long-term climate models?

KT: Warming has been well verified, but the models have major limitations, and regional climate is not very predictable. So, we need better observations and treatment of them. This includes assimilation of the data and its analysis into global gridded fields. The models also need to be improved.

M-M: What can we expect in the next couple of years?

KT: Because these extreme events lie outside what has been planned for, things like water systems and dikes and dams can be broken, as [seen] with Hurricane Katrina. The rains now are heavier than they used to be, so levees along the Mississippi and in California have also been breached. I expect that we will continue to see things we've never seen before.

http://www.miller-mccune.com/environment/crazy-weather-and-climate-do-dots-connect-30059/

Solutions to Water Supply Woes Surface in the West

In the quarter-century since Marc Reisner issued a grim prognosis for water in the American West, various entities have made efforts to reverse what once seemed inevitable.

By Arnie Cooper

In Tucson, Ariz., 700 single-family homes, 39 parks and 52 schools, including the University of Arizona, irrigate with reclaimed water.

It's easy to grow disillusioned in the face of so many grim statistics and pessimistic forecasts about the ramifications of the West's relationship with its water supply. But, as with so many of our challenges, the biggest barrier, according to international water expert Peter Gleick, is the need to overcome antiquated — in this case, 20th-century — thinking.

As Gleick has written and lectured about frequently, the philosophy of water managers during the last century was, "Whatever we need, we'll build it." During those decades of unbridled industrial expansion, there was little impetus to consider issues such as population, zoning, residential planning and home design.

The good news is that for all the negative talk — whether it's the strained relations between urban areas and agriculture or the indiscriminate placement of boggy golf courses in semi-deserts — there are signs that a paradigm shift is occurring.

One example is the growing interest in alternatives such as reclaimed water. "We used to think of waste water as a liability," Gleick says; "now, it's considered an asset." For example, in Tucson, 700 single-family homes, 39 parks and 52 schools, including the University of Arizona, irrigate with reclaimed water.

In addition, agricultural production and income have both continued to rise, even though irrigated land in the West is no longer expanding. But perhaps the most hopeful piece of evidence that we're already heading

down a different path is the decrease in per-capita water use in big Western cities. Gleick says that during the past 30 years, Los Angeles and most of the major urban areas have been functioning with less water, yet the population and the economy have continued to grow.

That's not to say water managers and residents can rest easy. Much work remains, but a sensible approach would consider the four strategies outlined in Gleick's "roadmap" for sustainable water resources in the Southwest.

The first, rethinking water supply, involves, as he writes, "sources of water that were previously ignored or unusable." This includes the reuse of treated waste water, which the town of Prescott Valley, Ariz., has been using for many years to irrigate its golf courses and recharge groundwater aquifers. And in a first for nuclear power plants, the region's Palo Verde Nuclear Generating Station is capitalizing on reclaimed water for its cooling system.

There's also a new, *old* idea: desalination. Further east, El Paso, Texas, recently built the largest inland brackish water-desal plant in the world, increasing the availability of fresh water to the city by 25 percent. Glen MacDonald, director of the UCLA Institute of the Environment and Sustainability, says this is a more practical, affordable approach than conventional desal using seawater, since brackish water is less saline. In any case, as with peak oil, "peak water," as Gleick terms it, is becoming increasingly hard to procure, meaning such expensive alternatives start to make more sense.

Rethinking water demand is the second strategy he advocates. As mentioned earlier, water districts have made great strides in efficiency without sacrificing economic productivity. One encouraging statistic revealed in Gleick's paper: The amount of water required to make steel has dropped from 200 tons of water per ton in the 1930s to just three in today's most efficient plants.

But Big Ag is lagging behind. Nearly half of all crops in California are still grown using wasteful flood irrigation. The good news is that there's a great deal of room for improvement through relatively simple steps, such as converting to drip irrigation and microsprinklers.

Arizona State University ecologist John Sabo takes this a step further, advocating increased farming on the Southern California coast, with its more temperate climate.

Three-Part Series

This is the final part of a three-part series looking at the legacy of the groundbreaking story of water use and abuse in the Western United States, "Cadillac Desert":

Part I — Greening the Desert? Not So Fast!

Part II — Water Shortages Threaten the American West Lifestyle

Part III — Solutions to Water Supply Woes Surface in the West

"Why are we growing so much corn in the Midwest?" he asks. "Why can't we grow vegetables with more nutritional value in water-rich places like the Midwest? Scientists need to put those possibilities on the table so politicians and economists can debate whether they're realistic in the market."

This brings us to Gleick's third strategy: improving institutional management. Flowing water does not respect state boundaries, creating friction between places like Nevada and Utah, which share groundwater basins. "New arrangements, especially in terms of improved clarity of federal/state responsibilities, can reduce

pressures on water," he writes. Currently, more than 20 different federal agencies share responsibility for an array of water issues.

And beyond consolidating water management is the need to quantify water use. Not all farmers are required to install water meters, leaving agencies with a poor understanding of how much agricultural water is being consumed. MacDonald asks, "Are we using the most efficient irrigation for crops? And are we growing the best crops for economic payback or food security or wise use of water? That's hard to know without sufficient water monitoring."

Finally, integrating climate change will need to be part of any solution. The crises previously discussed will only be exacerbated by decreased snowmelt, increased drought and erratic weather patterns. As Gleick warns, "the hydrologic cycle *is* the climate cycle."

So, while reducing greenhouse emissions won't prevent climate change, it can slow down its impact and reduce its severity. This is why California's Department of Water Resources includes integrating climate change into its short- and long-term planning, and an Oregon bill calls for "adaptation plans related to Climate Change." At the federal level, some awareness has been fostered by the year-old WaterSMART program.

"The federal government's existing water policies and programs simply aren't built for 21st-century pressures on water supplies," U.S. Interior Secretary Ken Salazar said in announcing WaterSMART (which stands for Sustain and Manage America's Resources for Tomorrow). "Population growth. Climate change. Rising energy demands. Environmental needs. Aging infrastructure. Risks to drinking-water supplies. Those are just some of the challenges."

For Sabo, the next step demands additional analysis by quantifying the critical regional and continental trade offs between water and carbon footprints of agriculture and industry.

"We need to assemble a team with carbon footprint, transportation, farming, and industrial lifecycle experts who can design incentives for industry and agriculture to best minimize the country's carbon-water footprint," he says. "Though it's a monumental task, it will put solutions on the table for politicians and economists to ponder and implement."

And while Sabo agrees this will be a monumental task, it will yield solutions for politicians and economists to implement.

As Marc Reisner wrote in the afterword to the revised edition of *Cadillac Desert*, "What it all boils down to is undoing the wrongs caused by earlier generations doing what they thought was right."

http://www.miller-mccune.com/environment/solutions-to-water-supply-woes-surface-in-the-west-31371/

Pricing Carbon to Reduce Emissions, Create Dividends

Proponents of the "Wesleyan Statement" say that America should tax carbon to reduce emissions, then return the money to citizens as a direct payment or a tax reduction.

By Judith D. Schwartz

Some advocate a direct, transparent price on carbon as an economic incentive for reducing fossil fuel use, with revenues returned to U.S. taxpayers. (bronswerk/istockphoto)

Cap and trade is dead — long live the Green Dividend.

That was the consensus of a conference on pricing carbon held late last year at Wesleyan University that produced the "Wesleyan Statement," a kind of working manifesto on carbon-pricing principles.

According to the resulting statement, an effective pricing strategy would be "upstream" (i.e. paid by the supplier), calibrated to reach emissions levels recommended by climate scientists, and steadily rising so that businesses and individuals can plan.

Speakers advocated a direct, transparent price on carbon as an economic incentive for reducing fossil fuel use, with revenues returned to U.S. taxpayers. Up for debate was whether this would be in the form of a direct payment (a "green check") or tax reduction ("tax shift").

Cap and trade, the cornerstone of the climate bill that squeaked through the House last summer only to die in the Senate, got a drubbing at the spirited event, which drew several hundred scholars, four members of Congress (including one Republican), students and activists, including climate-movement marquee names

such as James Hansen and Bill McKibben. The carbon-limiting plan was criticized as overly business-friendly and, in the words of U.S. Rep. Jim McDermott, D-Wash., "arcane, obtuse and abstruse."

Two key arguments for pricing carbon are that emission-spewing oil and coal are cheap relative to renewables because the fossil fuel industry is subsidized by tax breaks, and does not pay its products' environmental and societal costs. People will continue to use fossil fuels as long as they're cheap. A price on carbon would provide a spur to reduce energy use while making renewable sources competitive.

Hansen (see his remarks here) and others said carbon pricing would make the fossil fuel industry pay its own costs, rather than kicking the oil can down the road. There should be a "fee applied at the first sale at the point of entry that covers all oil, gas and coal-with no leakage," he said. "If the public and business community know the price will go up and stay up, there will be a quick response" in favor of renewable sources.

Hansen said that the hopeful news on climate change is that "if we phase out coal and extreme oil, [concentrations of] CO2 would peak at 420 parts per million and come down." He called carbon pricing the "one silver bullet" we have to make this happen. Hansen suggested one way that bullet might be delivered would involve the courts, and earlier this month he joined a lawsuit seeking to force U.S. government action on climate.

Any U.S. action faces major political hurdles. Environmentalism as a partisan litmus test is new, said Elaine Kamarck, lecturer in public policy at Harvard's Belfer Center for Science and International Affairs. It wasn't until 1998 and the run-up to Al Gore's presidential campaign, she said, that the topic became associated solely with the Democratic Party, as Republicans positioned themselves strongly against environmental causes such as climate change. She urged climate activists to "broaden the conversation" to reach conservatives and other segments of the population, such as "all the people who are sick and tired of going to wars for oil."

Former Republican Rep. Bob Inglis of South Carolina, who last June lost a primary bid for what would have been his seventh term in Congress, said Republicans should in theory support environmental action in line with the party's traditional emphasis on land and fiscal stewardship. "The GOP is losing credibility on national security because of [the climate] issue," he said, a lonely refrain that likely contributed to his loss.

One common argument against putting a price on carbon is that it will impede an economic recovery, but that argument made little headway at Wesleyan. (Or among many proponents of renewables.) "Saying carbon pricing is too expensive implies that it's optional," argued economist Frank Ackerman of the Stockholm Environmental Institute. He pointed to the increasing cost of inaction. According to estimates in the Stern Review, the damages from unchecked climate change would amount to 5 percent or more of the global gross domestic product and would increase over time; yet, almost all of these damages can be avoided by spending 1 percent of global GDP on mitigation.

As for the nitty-gritty of redistributing this carbon dividend, James Handley of the Carbon Tax Center recommended a commensurate reduction of payroll taxes. "We can have a job-creating carbon tax by returning it the right way," he said.

But author Peter Barnes, co-founder of the Working Assets Money Fund, suggests a program — the Sky Trust — modeled on the Alaska Permanent Fund with money sent to taxpayers electronically ("checks are so last century"). He noted that President Barack Obama lowered payroll tax withholding and no one noticed. "This is a strong argument why dividend is the way to go," Barnes said. "It also gets the discussion out of the tax box, which is a very bad box to be in."

Whether a carbon-pricing legislation manages to wend its way through the American political maze may be a moot point, Hansen says, as China may force the issue.

"There's a good chance China will adopt a carbon price because they want to phase out dirty energy," he said. "They will be out in front on these technologies and want to sell them to the rest of the world." China's adding a carbon duty to exports will provide a "strong incentive" to price carbon here, he said. Meanwhile, nations from Canada to Australia to South Africa are publicly grappling with carbon pricing.

"Washington will be inhospitable for a while" to action on climate change, said author and climate activist McKibben. But a price-and-dividend model, he said, could be a "tool that can bend that political reality. It's hard to bend political reality. But it's harder to bend chemistry and physics."

http://www.miller-mccune.com/environment/pricing-carbon-to-reduce-emissions-create-dividends-31344/

Plugging High-Speed Rail Into Germany's Power Grid

Using rail lines for the energy grid may help a suddenly nuclear-shy Germany transition to wider use of renewable sources.

By Michael Scott Moore

A photo of overhead lines on Japan Railway West. A recently nuclear-shy Germany may want to consider using rail lines like these for its energy grid as a transition to a wider use of renewable sources. (Wikipedia.org)

Germans, feeling the bite of necessity, have announced another use for their electrified rail network: It can carry green energy, too.

The German rail system has several thousand miles of high-voltage transmission lines that can be modified to broaden the national energy grid. And because of a seismic shift in German policy, the government has to find a quick solution to a daunting problem, namely how to move large amounts of renewable energy from one region to another. Wind turbines spin in the northeast, for example; but cities are growing in the south and west. The German grid would need around 2,240 miles of new high-voltage corridors to make renewable energy viable; about 60 miles have been built so far.

German officials last month said the government was eyeing train lines as a solution. "A close cooperation with Deutsche Bahn relating to the expansion of the power grid is something that I find attractive," said Rainer Brüderle, the country's economics minister, told journalists in April.

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.

It might seem obvious to use rail corridors for high-voltage lines. But a remarkable series of events brought Germany to this crossroads, which is unprecedented in the industrialized world.

The meltdowns at the Fukushima Dai-Ichi nuclear plant in March caused a crisis in Chancellor Angela Merkel's government in Berlin, because Merkel had spent the last two years easing the nation back to the idea of nuclear power. Her argument (until the earthquake and subsequent tsunami hit Japan) was that Germany couldn't possibly close all its nuclear plants, as planned by a previous government, and shift to other low-emission energies, as demanded by the European Union, all within the next decade.

The EU has agreed to boost renewable energies and slash carbon emissions drastically by 2020. Merkel intended to meet German commitments by letting the country's nuclear reactors run about 12 years past a rough deadline of 2021 imposed by her predecessor, Gerhard Schröder. It always did sound over-ambitious — running the world's fourth-largest industrial nation without a single nuclear plant.

And one reason Merkel wanted to keep the reactors live was that building a grid with enough high-voltage capacity for a far greener system would take so long. Germans, like people everywhere, don't want ugly new technology running through their backyards.

But Fukushima tipped the balance. After the earthquake and tsunami, Merkel flip-flopped with such astonishing speed that critics accused her of pandering for votes. (Germans have a deep grassroots distaste for nuclear power.) But now a report she's ordered from an ethics commission argues that a safe, nuclear-free German grid is feasible even without importing nuclear energy from the French. And Merkel believes Germany can do it, as long as the "energy transformation" — the Energiewende — is a national effort.

Integrating power lines so tightly with the rail system will cost money, of course — but only a quarter of the total estimate for a whole new grid. The work would involve changing the tension on some high-capacity cable or installing whole new lines.

One lesson for the U.S. is that high-speed rail can be used for more than just fast trains. But that's a trick we would have figured out; some areas run (older) power lines along (slower) rail corridors already.

The more important idea is that a rail system is a national resource, as Henry George pointed out more than a hundred years ago. Keeping it subsidized, efficient, and somewhat under the government's wing — like Deutsche Bahn, rather than British Rail — can pay off handsomely.

http://www.miller-mccune.com/science-environment/plugging-high-speed-rail-into-germanys-power-grid-31304/

Comet Theory Comes Crashing to Earth

An elegant archaeological hypothesis, under fire for results that can't be replicated, may ultimately come undone.

By Rex Dalton

Even though they can't replicate their work, the authors of a controversial scientific theory about a comet impact that caused the Clovis catastrophe refuse to give in to their many critics. (Wikimedia Commons)

It seemed like such an elegant answer to an age-old mystery: the disappearance of what are arguably North America's first people. A speeding comet nearly 13,000 years ago was the culprit, the theory goes, spraying ice and rocks across the continent, killing the Clovis people and the mammoths they fed on, and plunging the region into a deep chill. The idea so captivated the public that three movies describing the catastrophe were produced.

But now, four years after the purportedly supportive evidence was reported, a host of scientific authorities systematically have made the case that the comet theory is "bogus." Researchers from multiple scientific fields are calling the theory one of the most misguided ideas in the history of modern archaeology, which begs for an independent review so an accurate record is reflected in the literature.

"It is an impossible scenario," says Mark Boslough, a physicist at Sandia Laboratory in Albuquerque, N.M., where he taps the world's fastest computers for nuclear bomb experiments to study such impacts. His computations show the debris from such a comet couldn't cover the proposed impact field. In March, a

"requiem" for the theory even was published by a group that included leading specialists from archaeology to botany.

Yet, the scientists who described the alleged impact in a hallowed U.S. scientific journal refuse to consider the critics' evidence — insisting they are correct, even though no one can replicate their work: the hallmark of credibility in the scientific world.

The primary authors of the theory are an unusual mix: James Kennett, a virtual father of marine geology from the University of California, Santa Barbara; Richard Firestone, a physicist at Lawrence Berkeley Laboratory in California; and Allen West, an unknown academic from the mining industry who lives in Dewey, Ariz.

"We are under a lot of duress," said Kennett. "It has been quite painful." So much so, that team members call their critics' work "biased," "nonsense" and "screwed up."

Such intransigence has been seen before in other cases of grand scientific claims. Sometimes those theories were based on data irregularities. Other times, the proponents succumbed to self-delusion. But typically, advocates become so invested in their ideas they can't publicly acknowledge error.

A new look at the comet claim suggests all of these phenomena may be in play, apparently creating a peculiar bond of desperation as the theory came under increasing attack. Indeed, the team's established scientists are so wedded to the theory they have opted to ignore the fact their colleague "Allen West" isn't exactly who he says he is.

West is Allen Whitt — who, in 2002, was fined by California and convicted for masquerading as a state-licensed geologist when he charged small-town officials fat fees for water studies. After completing probation in 2003 in San Bernardino County, he began work on the comet theory, legally adopting his new name in 2006 as he promoted it in a popular book. Only when questioned by this reporter last year did his co-authors learn his original identity and legal history. Since then, they have not disclosed it to the scientific community.

West's history — and new concerns about study results he was integrally involved in — raise intriguing questions about the veracity of the comet claim. His background is likely to create more doubts about the theory. And the controversy — because it involves the politically sensitive issue of a climate shift — is potentially more broadly damaging, authorities suggest.

"It does feed distrust in science," says Wallace Broecker, a geochemist at Columbia University and an international dean of climate research. "Those who don't believe in human-produced global warming grab onto it."

West is at the nexus of almost all the evidence for the original comet claims. His fieldwork is described in the 2006 book he authored with Firestone, *The Cycle of Cosmic Catastrophes*.

To show the comet's deadly plume, West collected various sediment samples from 25 archaeology sites across the United States. He used a magnet to find iron flecks reportedly from the comet, scooped up carbon spherules reflecting subsequent fires, and argued that high concentrations of such material at particular sedimentary levels supported their theory.

The team has argued a 4-kilometer comet tumbled into ice sheets 12,900 years ago, leading to the so-called Younger Dryas, when the temperature cooled for more than a thousand years.

The flying debris appeared to answer questions about the Clovis peoples' disappearance that had defied prior explanation. The supposed remnants of the comet hadn't received intense scrutiny by researchers previously

probing sediments at archaeology sites. And water from melted ice flowing into the oceans could explain the precipitous temperature drop.

But all these claims have been sharply disputed in a series of scientific articles over the last 18 months. Examples include:

University of Wyoming archaeologist Todd Surovell and his colleagues couldn't find increased magnetic spherules representing cosmic debris at seven Clovis sites. Nicholas Pinter and his colleagues at Southern Illinois University Carbondale argue the carbon spherules are organic residue of fungus or arthropod excrement. And Tyrone Daulton of Washington University in St. Louis and his colleagues reported that supposed nanodiamonds formed by the impact were misidentified.

Speaking of the various reports, Surovell said, "We all built a critical mass of data suggesting there was a serious problem."

Now, Boslough and colleagues have conducted new analysis of purported comet debris samples that raises even more troubling credibility questions.

On March 25, Boslough reported that radio-carbon dating of a carbon spherule sample shows it is only about 200 years old — an "irregularity" that indicates is it not from the alleged 12,900-year-old impact time.

This means that a sample from a layer purporting to show a high concentration of spherules at the inception of the Younger Dryas actually only was about as old as the Declaration of Independence.

About two years ago, as his doubts on the theory were building, Boslough contacted West to secure carbon spherule samples for analysis. West sent him 16 spherules, purportedly from the Younger Dryas boundary sediment layer at an archaeology site called Gainey in Michigan — a location with the highest spherule count of studied locations.

Boslough subsequently forwarded the unopened package of spherules to the National Science Foundation-funded radio-carbon laboratory at the University of Arizona in Tucson. There, a dating specialist randomly selected a spherule — the one ultimately found to be about 200 years old. Boslough reported these results at an American Geophysical Union conference in Santa Fe, N.M.

Afterward, Boslough said: "I don't think there is any reason to accept what West reported. I have a serious problem with everything from him."

Did someone salt a sediment layer to increase the spherule count? Or did the 200-year-old sample inadvertently get mixed in somehow? Boslough says he can't provide an answer, but there was some form of "contamination."

But an answer is needed, he said: "I wouldn't sweep it under the rug."

After his presentation, West wrote Boslough that he believed that the questioned sample somehow got mixed naturally over time into a lower sediment layer. Both Kennett and Firestone agreed.

But Vance Holliday, a University of Arizona archaeologist who has studied Clovis sites for 30 years, found this explanation nonsensical. Such mixing of spherules from different eras could invalidate any conclusion that higher spherule counts represented evidence of a comet impact.

"I suspect something very odd is going on," adds Holliday, who also has become a critic of the comet theory.

After the theory was first announced in 2007 in Acapulco, Mexico, Holliday had attempted to collaborate with Kennett to test the idea. But Kennett effectively blocked publication of the study last year after the results didn't support the comet theory.

And those results were blindly analyzed by an independent reviewer selected by Kennett himself. That independent reviewer was none other than Walter Alvarez — an esteemed University of California, Berkeley, geologist and son of Luis Alvarez, the Nobel Prize-winning physicist who first proposed an asteroid struck the Yucatan Peninsula in Mexico about 65 million years ago, wiping out the world's dinosaurs and most life.

The Holliday-Kennett study has never been presented publicly. The results were obtained independent of the two authors. Holliday then agreed to discuss events; Kennett also answered questions about the study but didn't reach the same conclusions as his colleague.

For decades, Holliday has studied a Clovis site at Lubbock Lake Landmark State Historical Park in Texas, just east of the original location where the Clovis people's distinctive fluted projectile points were first discovered in New Mexico. After a visit there in the summer of 2007, Holliday examined sediments from an exposed section that included the signature of the inception of the Younger Dryas. He then took samples from six sedimentary layers within a 35-centimeter section encompassing the Younger Dryas.

The study then worked like this: Based on analyses of the layers, both Kennett and Holliday sent to Alvarez their predictions on which layer reflected the geochemical characteristics for the beginning of the Younger Dryas. But neither Kennett nor Alvarez knew the order of the sediment layers; not knowing this order would add credibility to their conclusions.

In a surprise, Kennett's analysis included sedimentary counts for what he called nanodiamonds — which his group says were produced by the enormous energy from comet explosion.

Holliday accurately predicted what layer was associated with the Younger Dryas boundary. But Kennett did not. Kennett's selected nanodiamond-rich layer was 25 centimeters above the Younger Dryas boundary — meaning it was about 1,000 years younger than the claimed impact time. To Alvarez, this indicated a comet-impact hypothesis was incorrect.

After considerable behind-the-scenes arguing, Holliday said, Kennett ultimately complained last summer that the study was "fundamentally flawed" and wouldn't allow him to publish his results. Now, Kennett says, he is continuing to analyze the data.

"It is very peculiar," Holliday said. "They propose an idea, a study contradicts it, then they criticize the scientists or the work."

Both Kennett and Columbia's Broecker, are elected members of the prestigious U.S. National Academy of Science; near age peers, they are also old friends. Years ago, Broecker noted, Kennett published seminal discoveries on ancient climate shifts by studying cores drilled deep into the ocean floor.

Speaking graciously of Kennett, Broecker lauded his friend's early climate studies as extremely important. But when the comet theory came along, Broecker immediately was highly skeptical. Kennett repeatedly called him to lobby for the comet until Broecker cut him off saying he didn't want to hear about the theory anymore.

"It is all wrong," said Broecker, if not "very likely total nonsense. But he never gives up on an idea."

Kennett seems fixated on the Younger Dryas, Broecker added, "He won't listen to anyone. It's almost like a religion to him."

Acknowledging the dispute, Kennett said, "I know he thinks I'm wrong; maybe he'll change his mind someday."

About 20 years ago, Broecker noted Kennett had proposed a similarly wayward theory that a burst of methane from the ocean floor — sometimes called "a methane gun" — warmed the climate, ending the Younger Dyras.

"He pushed the methane-gun theory for years," said Broecker. "He predicted an enormous methane peak would be reflected in ice-core records. But there wasn't one; it was a ridiculous idea to begin with."

Then he switched to the beginning of the Younger Dryas, Broecker added, "He was determined to make a splash; it blinded his judgment."

Ironically, he may be making a different type of impact with his odd-couple collaboration with West.

West has no formal appointment at an academic institution. He has said he obtained a doctorate from a Bible college, but he won't describe it further. Firestone said West has told him he has no scientific doctorate but is self-taught. West's Arizona attorney refers to him in writing as: "A retired geophysicist who has had a long and distinguished career."

In the early 1990s, a new-age business West was involved in Sedona, Ariz., failed, and his well-drilling company went bankrupt. Then he ran afoul of California law in small Mojave Desert towns in a scheme with two other men, with court records saying they collected fees up to $39,500 for questionable groundwater reports.

He originally was charged with two felonies for falsely representing himself as a state-licensed geologist but agreed to a no contest plea to a single misdemeanor of false advertising as part of plea bargain in which state records say he was fined $4,500. Two other men in the scam also were sanctioned.

Acknowledging he made a mistake, West has sought to downplay the 9-year-old conviction. And last September, after his impact theory colleagues learned of it, he went back to court in Victorville, Calif., convincing a judge to void the old plea.

After earlier denying any impropriety with his Younger Dryas work, West declined a recent interview request. Last month, he wrote a letter charging it was "highly prejudicial and distorted" to bring up his legal past in the context of his current studies. He is a member of "a group of two dozen dedicated scientists performing cutting-edge, although controversial, research," he wrote.

Initially last year, Kennett was speechless when confronted with West's history. He and Firestone learned of it because of this reporter's questions. Since then, he has continued to collaborate and publish research with West. Within weeks of learning of West's background, Kennett pushed for news coverage last September of an article contending nanodiamonds in Greenland supported their comet theory. But the article didn't sway critics.

Today, Kennett won't discuss West's criminal past at all — saying West is "wonderful, an absolutely remarkable researcher." Firestone acknowledges West "did some strange things" but continues to defend that his work is above reproach.

Among the theory's critics, there are decidedly differing opinions.

"This is so far beyond the pale — outside of normal experiences in conducting science — you can't ignore it," Southern Illiois' Pinter said. Asked if he would collaborate with West, he said, "I would run screaming away."

And the three years and research dollars spent on the claim leave a bitter memory for some. "My response is not publishable," said Pinter.

Some academic institution needs to thoroughly examine the issue and answer the obvious questions that abound, critics say. Several said they already would have reported the events to administrators at their respective universities.

UCSB is the most likely institution to conduct a review, since Kennett used an NSF grant there on comet studies. But this will mean questioning an esteemed faculty member — Kennett — who is seen as having helped put the campus on the international scientific map.

Among those who believe a formal inquiry should be initiated to determine if there was any misconduct is Jeffrey Severinghaus, an isotopic chemist at the University of California, San Diego's Scripps Institution of Oceanography. An inquiry is the first level of such scrutiny; an investigation that could lead to sanctions would follow if the inquiry finds evidence of impropriety. Such probes have sniffed out questionable data from cases such as the rejected cold fusion claim and the false Korean assertion of cloning human embryos from stem cells.

"Wow," said Severinghaus upon hearing of the latest developments in the comet theory, which he initially doubted because of his earlier ice-core studies. "It certainly sounds like there is sufficient evidence to justify an initial inquiry."

Asked if he would seek such a move, he said, "Absolutely. It is really important to maintain the public trust in science. That means if there is a bad apple, it is rooted out and exposed."

Bruce Hanley, UCSB's director of research compliance, declined to be interviewed, although in an email he wrote that UCSB "is extremely interested in maintaining a high level of integrity" in research, and has a formal process for review of "unacceptable research practices." Such a review is done confidentially.

Meanwhile, the next stop for the comet proponents' road show is Bern, Switzerland. In July, they are scheduled to present research to a major international conference that studies the last 2.5 million years, the quaternary.

With many leading impact scientists in Europe equally skeptical of the theory, their welcome may be as icy as that period often was.

http://www.miller-mccune.com/science/comet-claim-comes-crashing-to-earth-31180/

Sensory Deprivation Boosts Musicians' Skill Level

Canadian researchers report floating in an isolation tank increased the technical skill level of young jazz players.

By Tom Jacobs

Forget practicing scales, how about trying altered states? A new Canadian experiment suggests floating in an isolation tank may increase the technical ability of musicians. (istockphoto.com)

How do you get to Carnegie Hall? Everybody knows the standard answer. But newly published research suggests that, after you've labored all day in the practice room, you might want to spend an hour in a flotation tank.

Oshin Vartanian of the University of Toronto and Peter Suedfeld of the University of British Columbia report floating in an Epsom salt solution one hour per week for four weeks boosted the technical ability of a group of college music students. This suggests such periods of minimal sensory stimulation can improve performers' perceptual-motor coordination.

Don't start filling up the bathtub, however: This experiment, described in the journal *Music and Medicine,* featured a level of sensory deprivation achievable only in a specially designed tank. The device was invented in the 1950s by neuroscientist John Lilly; in the years since, its use has been linked to improved sports performance and heightened levels of creativity.

But would it work for budding be-boppers? To answer that question, the researchers conducted an experiment using 13 students enrolled in an intermediate-level jazz improvisation course at Vancouver Community College.

Eight of the students — six men and two women — engaged in flotation sessions for four consecutive weeks. They spent an hour each week in a fiberglass shell, floating in a solution of Epsom salts and skin-temperature water. They were in the dark, and outside sounds were muffled.

All the participants — including the other five musicians who comprise the comparison group — made two five-minute-long recordings in which they freely improvised. The first took place one week before the flotation sessions began; the second, one week after the sessions concluded. Each session was rated by the instructor (who was unaware which students were undergoing the treatments) on five dimensions: improvisation, creativity, expressiveness, technical ability and overall quality.

The researchers found "a significant difference between the treatment and comparison groups on technical ability, but not on any other dimension," the researchers write. Thanks to this enhanced skill level, those who had floated "had significantly higher grades in the jazz improvisation class than the comparison group."

Vartanian and Suedfeld concede this was a small sample. But they note that, based on their initial recordings, the instructor rated the treatment and comparison groups essentially equal on all five dimensions. Since "The two groups can be considered equivalent in terms of motivation and baseline ability," the difference in their ability was very likely the result of the flotation sessions.

So why didn't the treatment group's creativity scores also rise? The researchers suspect this reflects the one-week lag time between the final flotation session and the second recording.

That was purposeful on their part: They wanted to gauge long-lasting rather than immediate effects. (Previous research found increased creativity in university students after floating sessions measured their abilities immediately after they left the tank and dried off.)

Of course, for a musician, technical expertise can inspire increased creativity, as it gives one the confidence to take risks. So perhaps this boost in skill will lead to higher levels of originality in the long run.

In any event, the results suggest this technique holds considerable promise for musicians in general and jazz artists in particular. As Vartanian and Suedfeld note, flotation isolation "has been shown to induce a state of relaxed alertness, concentration and reduced stress."

Which is exactly where you want to be when the bandleader gives his cue.

http://www.miller-mccune.com/culture-society/flotation-isolation-boosts-musicians-skill-level-31182/

Obesity Virus, Fat Chickens and Life's Mysteries

Obesity virus kills thousands … of chickens. And it also reveals how little we know about humans.

By Rob Dunn

Fat chickens were the key to a virus that may have a link to solving the problem of human obesity. One researcher believes so. (istockphoto.com)

Viruses can make you fat — and your dirty-fingered friends can give these viruses to you.

That is the punch line — a known truth about the world. The set-up, though, is longer in the telling. It begins with a boy named Nikhil living in India.

When Nikhil Dhurandhar was young, his father directed a large obesity clinic in Bombay. Throughout his childhood, Nikhil saw thousands of his father's obese patients. They came in for some cure, whether salve or salvation. Instead, they received, again and again, the same advice: "Move more. Eat less."

It is what doctors around the world tell their patients. You might have heard the same advice. It echoes on TV, across magazines and everywhere else, bouncing throughout our society. Sometimes the advice works, but more often, it does not.

As he grew up, Nikhil came to feel a deep sympathy for the many patients who tried and failed to lose weight. He wanted to help, but he also wanted to do something more than offer advice. Despite huge sums of money spent on the diet industry each year in Bombay and nearly everywhere else, the best that doctors can do, short of pills and expensive surgeries, is to look their patients in the eyes and, in each of a hundred different languages, tell them what, in most cases, they already know.

Dhurandhar did what he could. He went to the U.S. for a master's degree in 1987 and then returned to Bombay to work as a clinician beside his father while simultaneously doing research for his doctorate. On the days he was in the clinic, he stood beside his father and said, "Move more. Eat less." He uttered those words so often that they became more like a prayer than advice. He imagined himself praying like this over his patients each day for the rest of his life. Then things changed.

In 1988, Dhurandhar was looking for insight and had grown curious about a family friend, Sharad M. Ajinkya. Ajinkya was a well-known and accomplished veterinary researcher. Dhurandhar began to read Ajinkya's work and noticed his papers on the virus SMAM-1, which had caused the deaths of thousands of chickens in India in the early 1980s.

One day, not much later, Dhurandhar and Ajinkya had a conversation that would change Dhurandhar's life. The topic of chicken viruses came up. Ajinkya mentioned that the chickens he had studied, the ones with the virus SMAM-1, were fat. They had big kidneys and fat around the abdomen. Ajinkya had noticed the chickens' fat, but he hadn't thought it unusual, not really, just one observation in a career of millions of noticed details.

As the two men talked, Dhurandhar grew excited. What started as dinner-party banter became something entirely different. "Stop right there. Did you say that the chickens had fat abdomens?" Dhurandhar asked.

"Yes, yes they did."

"Why is there fat in the abdomen?"

"Well, I'm not sure. I hadn't really thought about it."

"Is it possible that the virus made the chickens fat? That is, could the virus cause, in the chickens, obesity?"

Ajinkya's response was key to what would follow. Had he said "no," Dhurandhar might have continued along some other line of conversation — the monsoons or the rising price of gas.

Whole lives can turn sometimes on a single, well-placed word; so, too, the absence of one. Ajinkya didn't say no. He said, "I don't know." That, for Dhurandhar, was enough. Stokedby Ajinkya's observations and uncertainty, Dhurandhar's mind began to spin. He thought, or maybe he even said aloud: Is it possible that human obesity is caused by a virus?

With caution, the pair began to investigate.

Like two teenagers who have just found the entrance to a previously hidden cave, they pulled out their lights and began to look in. First, they would verify Ajinkya's observation experimentally. They located some healthy, germ-free chickens and gave them SMAM-1. Within six weeks, the infected chickens were 30 to 50 percent fatter than the uninfected individuals, even though they had eaten the same food. This was amazing! It could have been a fluke, though.

They hadn't tested many chickens, so they found a hundred more — one hundred Leghorn broilers — and did the test again. So much depended on those white chickens. The results came back: More fat chickens!

Not only were these chickens fat, they also had lower cholesterol and triglycerides than did the "healthy" chickens. Something strange — but to Dhurandhar's mind, wonderful — was going on.

Now came a point of reckoning for the two scientists. They were in too deep to turn back, but there were at least two paths. They could keep working on the chickens and figure out, in great detail, the biochemistry linking virus and fat, or they could go big and test their radical ideas on humans. If they wanted their findings to be believed, they probably needed to move slowly and cautiously. The most rational approach was to learn more about what was going on in the chickens and then come back to humans once they understood.

Yet, at that moment, prudence was the last thing on their minds. Dhurandhar had seen thousands of obese patients. If any single one of them could have been obese because of something as simple as a virus, he needed to know. He could not — would not — wait for details.

Temporarily, prudence won over. Dhurandhar was excited and ready to do more, but he was still not quite sure what it was that he and Ajinkya were seeing. He decided to try to figure out what else was known about diseases and fat. They had access to only a handful of scientific journals, so Dhurandhar did something both improbable and a little silly. In the days before the Internet or email, he wrote the U.S Library of Congress a letter that began, "Dear to whom it may concern …" asking that if anyone else had already published anything on fat and viruses, would the librarians please let them know what there was. It was a message in a bottle flung blindly at a faraway librarian.

Amazingly, someone wrote back. Some saintly human went and checked the shelves. He or she did better than that: They actually found the articles and sent them to Dhurandhar, breaking to him the news that there were older studies showing links between viruses and fat, albeit in mice. Dhurandhar was disappointed, in a way, to not have been the first, but he was also emboldened. His was not the only evidence. The more he thought about it, the more emboldened he became. He had the confirmation he had needed. It was time to go big. He and Ajinkya would test their theory on humans.

But how could they test their nascent theory on their fellow man?

"Come try a piece of my fat, infected chicken" just didn't seem appropriate or moral — or even legal. What they could do was to test humans for antibodies to SMAM-1 and see if the fattest individuals were also the most likely to have the virus.

Ajinkya and Dhurandhar tested 52 of Dhurandhar's patients. Ten of the patients had antibodies for SMAM-1. Lo and behold, those 10 were heavier than the other 42 patients and more of their body weight was made up of fat. Like the infected chickens, they also had lower cholesterol. Suddenly, Dhurandhar, thanks to his work with Ajinkya, had a grand, new, sweeping theory about fat in humans. What he had discovered, if he was right, was relevant to billions of men and women.

Nearly a fifth of people in developed countries are obese. Dhurandhar was convinced that obesity was a disease caused, at least sometimes, by a virus. He was beginning to think at least some obesity was contagious. Some days, he thought most obesity was contagious; other days, just some. Either way, if even a handful of cases had such an origin, such cases might be prevented with a vaccine. Perhaps he could someday tell some of his patients something more helpful than "Move more. Eat less."

In his excitement, Dhurandhar decided he needed to move to the United States. He needed to go somewhere his bold new research could get funded and where he could get better access to scientific publications. In addition, obesity is a bigger problem in the U.S. than perhaps anywhere else in the world, by some measures the biggest public health problemi. In his enthusiasm, he said goodbye to his father and the rest of his family and moved, with his wife and son, to America. He was prepared to do whatever it took, so he did what he had long told his patients to do — he moved more. If things got rough, he was prepared to eat less. He was traveling to a new life on hope and a theory. At least initially, this would turn out to be a mistake.

Up to that point, Dhurandhar had been lucky. In the U.S., he would try again. He visited scientists, made phone calls and wrote letters. His letters in particular seemed like a long, long shot — a Powerball ticket. He wrote to anyone doing work remotely related to his interests, to explain that he had a big new theory and that he was in need of a job. He mentioned that the theory included the idea that obesity was contagious. He also mentioned his as-yet-unpublished experiments on humans, which were, for all the recipients of his letters knew, entirely imaginary. He then waited. No one responded.

Dhurandhar's excitement about his idea was not shared. The scientists he hoped might enthusiastically hire him came to see him, he thought, as "that fat chicken guy," or even "that crazy fat chicken guy." And why wouldn't they? He was a young man with a wild idea and little to back it up. He had not yet done very much to make academics take notice.

He had published just a few scientific papers, one of them on the nutritional quality of dog food and another on fat chickens. On the basis of those papers and additional but unpublished research, he was proposing the radical idea that a virus, rather than just eating too much and exercising too little, was making people all over the world fat. Dhurandhar had only recently graduated from a doctoral program that was not well-known in the U.S. On top of that, there are thousands of doctoral students applying for jobs in any given year.

So when Dhurandhar came to the U.S., independent of whether or not his idea was good or not, radical or not, or passionate or not, he had just a slim chance of getting a job. It was likely that he would go unemployed and drift, along with his theory, into oblivion. That is what happened. By June of 1994, he decided to return with his family to Bombay. His dream had proven too improbable. He, and his wild idea, would head home.

Then an amazing thing happened: someone responded. One of his letters had landed on the desk of Richard Atkinson, an obesity specialist at the University of Wisconsin. Atkinson had himself thought about the idea that viruses might influence obesity. He offered Dhurandhar a job in his lab in Wisconsin working on chickens, viruses and fat.

From there, Dhurandhar tirelessly tested his chicken-fat theory again and again, now using the virus Ad-36 — which, unlike SMAM-1, is a human adenovirus and so, potentially, even more consequential — but this time in small steps. He would, he thought, make it to humans, but not all at once.

First he published a general paper on fatness in animals and the presence of viruses. Then he developed a new method to test for the effects of Ad-36. Then he showed that one chicken could catch fatness from another chicken because of the virus, and both would become fatter. Then, in 2002, he made a bigger jump: He showed that the virus, when given in the lab to rats or marmosets, made them fat, too. But even then, he didn't go back to humans — not yet.

Dhurandhar is now an associate professor at the Pennington Biomedical Research Center in Louisiana. He and his ideas have survived and now, finally, in the last few years, Dhurandhar has come back to working on humans. Dhurandhar and Atkinson recently checked over 500 lean and obese adults for Ad-36. Thirty percent of the obese patients showed evidence of the virus, but only 11 percent of the lean individuals did. His work on humans seems to show that when we are infected with this virus, it tells the body to make fat cells — cells that favor the viruses' own reproduction — though exactly how or why remains unclear.

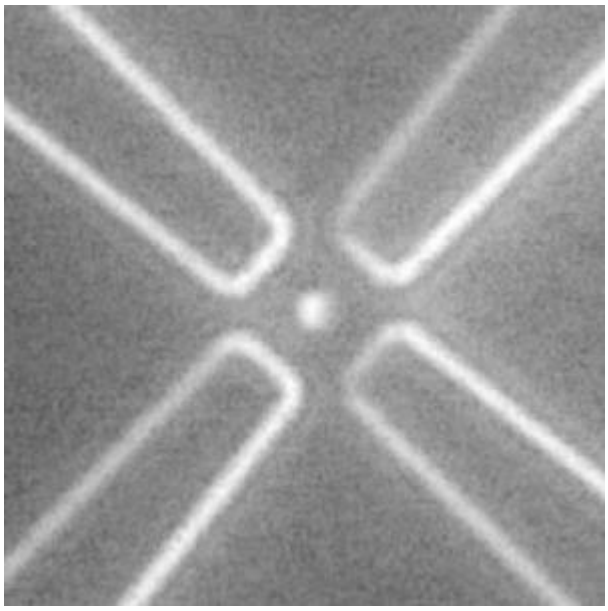
In the end, there are two lessons from Dhurandhar's work, lessons bigger than the story of viruses and fat. The first lesson is that the wild workings of our bodies influence who we are. They influence our behavior, our weight, our metabolism and nearly everything else. We are what we eat, but we are also, it appears, what eats us.

The second lesson, though, is the broader one: that we are still so ignorant about our own bodies that a man at a dinner party in Bombay can have an insight during a conversation about chickens that fundamentally changes how we view who we are. We are so ignorant to the fact that the wildest ideas about what might be can sometimes really be.

We have gone to the moon, but nearer at hand, your life is a mystery, and so is mine and so are everyone else's — trillions and trillions of mysteries, some of them fat and some of them thin, and all of them grand.

http://www.miller-mccune.com/health/obesity-virus-fat-chickens-and-lifes-mysteries-31424/

Particle Trap Paves Way for Personalized Medicine



Scientists were able to trap a single particle between four microelectrodes, paving the way for a faster and cheaper way to sequence DNA. (Credit: Weihua Guan and Mark Reed/Yale University)

ScienceDaily (May 23, 2011) — Sequencing DNA base pairs -- the individual molecules that make up DNA -- is key for medical researchers working toward personalized medicine. Being able to isolate, study and sequence these DNA molecules would allow scientists to tailor diagnostic testing, therapies and treatments based on each patient's individual genetic makeup.

But being able to isolate individual molecules like DNA base pairs, which are just two nanometers across -- or about 1/50,000th the diameter of a human hair -- is incredibly expensive and difficult to control. In addition, devising a way to trap DNA molecules in their natural aqueous environment further complicates things. Scientists have spent the past decade struggling to isolate and trap individual DNA molecules in an aqueous solution by trying to thread it through a tiny hole the size of DNA, called a "nanopore," which is exceedingly difficult to make and control.

Now a team led by Yale University researchers has proven that isolating individual charged particles, like DNA molecules, is indeed possible using a method called "Paul trapping," which uses oscillating electric fields to confine the particles to a space only nanometers in size. (The technique is named for Wolfgang Paul, who won the Nobel Prize for the discovery.) Until now, scientists have only been able to use Paul traps for particles in a vacuum, but the Yale team was able to confine a charged test particle -- in this case, a polystyrene bead -- to an accuracy of just 10 nanometers in aqueous solutions between quadruple microelectrodes that supplied the electric field.

Their device can be contained on a single chip and is simple and inexpensive to manufacture. "The idea would be that doctors could take a tiny drop of blood from patients and be able to run diagnostic tests on it right there in their office, instead of sending it away to a lab where testing can take days and is expensive," said Weihua Guan, a Yale engineering graduate student who led the project.

In addition to diagnostics, this "lab-on-a-chip" would have a wide range of applications, Guan said, such as being able to analyze how individual cells respond to different stimulation. While there are several other

techniques for cell-manipulation available now, such as optical tweezers, the Yale team's approach actually works better as the size of the targets gets smaller, contrary to other approaches.

The team, whose findings appear in the May 23 Early Edition of the *Proceedings of the National Academy of Sciences,* used charged polystyrene beads rather than actual DNA molecules, along with a two-dimensional trap to prove that the technique worked. Next, they will work toward creating a 3-D trap using DNA molecules, which, at two nanometers, are even smaller than the test beads. They hope to have a working, 3-D trap using DNA molecules in the next year or two. The project is funded by a National Institutes of Health program that aims to sequence a patient's entire genome for less than $1,000.

"This is the future of personalized medicine," Guan said.

The project was directed by Mark Reed (Yale University) and Predrag Krstic (Oak Ridge National Laboratory). Other authors of the paper include Sony Joseph and Jae Hyun Park (Oak Ridge National Laboratory).

Story Source:

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

Journal Reference:

1. Weihua Guan, Sony Joseph, Jae Hyun Park, Predrag S. Krstić, Mark A. Reed. **Paul trapping of charged particles in aqueous solution**. *Proceedings of the National Academy of Sciences*, 2011; DOI: 10.1073/pnas.1100977108

http://www.sciencedaily.com/releases/2011/05/110523152340.htm

Children Learn Language in Moments of Insight, Not Gradually Through Repeated Exposure, Study Shows

Åssociative theory experiments (below) don't resemble the real world. (Credit: Proceedings of the National Academy of Sciences)

ScienceDaily (May 23, 2011) — New research by a team of University of Pennsylvania psychologists is helping to overturn the dominant theory of how children learn their first words, suggesting that it occurs more in moments of insight than gradually through repeated exposure.

The research was conducted by postdoctoral fellow Tamara Nicol Medina and professors John Trueswell, and Lila Gleitman, all of the Department of Psychology in Penn's School of Arts and Sciences and the University's Institute for Research in Cognitive Science, and Jesse Snedeker, a professor at Harvard University.

Their work was published in the journal *Proceedings of the National Academy of Sciences* last week.

The current, long-standing theory suggests that children learn their first words through a series of associations; they associate words they hear with multiple possible referents in their immediate environment. Over time, children can track both the words and elements of the environments they correspond to, eventually narrowing down what common element the word must be referring to.

"This sounds very plausible until you see what the real world is like," Gleitman said. "It turns out it's probably impossible."

"The theory is appealing as a simple, brute force approach," Medina said. "I've even seen it make its way into in parenting books describing how kids learn their first words."

Experiments supporting the associative word learning theory generally involve series of pictures of objects, shown in pairs or small groups against a neutral background. The real world, in contrast, has an infinite

number of possible referents that can change in type or appearance from instance to instance and may not even be present each time the word is spoken.

A small set of psychologists and linguists, including members of the Penn team, have long argued that the sheer number of statistical comparisons necessary to learn words this way is simply beyond the capabilities of human memory. Even computational models designed to compute such statistics must implement shortcuts and do not guarantee optimal learning.

"This doesn't mean that we are bad at tracking statistical information in other realms, only that we do this kind of tracking in situations where there are a limited number of elements that we are associating with each other," Trueswell said. "The moment we have to map the words we hear onto the essentially infinite ways we conceive of things in the world, brute-force statistical tracking becomes infeasible. The probability distribution is just too large."

To demonstrate this, the Penn team conducted three related experiments, all involving short video segments of parents interacting with their children. Subjects, both adults and preschool-aged children, watched these videos with the sound muted except for when the parent said a particular word which subjects were asked to guess; the target word was replaced with a beep in the first experiment and a nonsense placeholder word in the second and third.

The first experiment was designed to determine how informative the vignettes were in terms of connecting the target word to its meaning. If more than half of the subjects could correctly guess the target word, it was deemed High Informative, or HI. If less than a third could, the vignette was deemed Low Informative, or LI. The latter vastly outnumbered the former; of the 288 vignettes, 7 percent were HI and 90 percent were LI, demonstrating that even for highly frequent words, determining the meaning of a word simply from its visual context was quite difficult.

The second experiment involved showing subjects a series of vignettes with multiple target words, all consistently replaced with nonsense placeholders. The researchers carefully ordered the mixture of HI and LI examples to explore the consequences of encountering a highly informative learning instance early or late.

"In past studies of this kind, researchers used artificial stimuli with a small number of meaning options for each word; they also just looked at the final outcome of the experiment: whether you end up knowing the word or not," Trueswell said. "What we did here was to look at the trajectory of word learning throughout the experiment, using natural contexts that contain essentially an infinite number of meaning options."

By asking the subjects to guess the target word after each vignette, the research could get a sense of whether their understanding was cumulative or occurred in a "eureka" moment.

The evidence pointed strongly to the latter. Repeated exposure to the target word did not lead to improved accuracy over time, suggesting that previous associations hypotheses were not coming into play.

Moreover, it was only when subjects saw an HI vignette first did the accuracy of their final guesses improve; early HI vignettes provided subjects with the best opportunity to learn the correct word, and most guessed correctly when presented with them. Confirming evidence helped "lock in" the correct meaning for these subjects who started on the right track.

"It's as though you know when there is good evidence, you make something like an insightful conjecture," Gleitman said.

However, when subjects saw an LI vignette first they tended to guess incorrectly and, although they revised these guesses throughout the experiment, they were ultimately unable to arrive at the correct meaning. This showed that these subjects had no memory of plausible alternative meanings, including the correct one, from earlier vignettes that they could return to.

The third experiment showed that the inability to hold these incorrect meanings in mind is necessary for how word acquisition likely works. After a delay of a couple days, subjects saw vignettes on the same target word they missed before but showed no evidence of retaining their incorrect assumptions.

"All of those memories go away," Gleitman said. "And that's great! It's the failure of memory that's rescuing you from remaining wrong for the rest of your life."

Future work by members of the Penn team will investigate what makes certain interactions more or less informative when it comes to word meaning, as well as the order in which people process visual information in their environment. Both avenues of research could help rewrite textbooks and parenting guides, suggesting that rich interactions with children -- and patience -- are more important than abstract picture books and drilling.

The research was supported by the National Institutes of Health.

Story Source:

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

Journal Reference:

1. T. N. Medina, J. Snedeker, J. C. Trueswell, L. R. Gleitman. **How words can and cannot be learned by observation**. *Proceedings of the National Academy of Sciences*, 2011; DOI: 10.1073/pnas.1105040108

http://www.sciencedaily.com/releases/2011/05/110523145054.htm

Ants Give New Evidence for Interaction Networks

Singled out by unique color codes, ants provide evidence through their interactions that challenges previous assumptions about how social networks function. (Credit: Benjamin Blonder)

ScienceDaily (May 20, 2011) — Be it through the Internet, Facebook, the local grapevine or the spread of disease, interaction networks influence nearly every part of our lives.

Scientists previously assumed that interaction networks without central control, known as self-directed networks, have universal properties that make them efficient at spreading information. Just think of the local grapevine: Let something slip, and it seems like no time at all before nearly everyone knows.

By observing interactions in ant colonies, University of Arizona researcher Anna Dornhaus and doctoral candidate Benjamin Blonder have uncovered new evidence that challenges the assumption that all interaction networks have the same properties that maximize their efficiency. The National Science Foundation-funded study was published in the *Public Library of Science* on May 20.

"Many people who have studied interaction networks in the past have found them to be very efficient at transferring resources," said Blonder. "The dominant paradigm has been that most self-organized networks tend to have this universal structure and that one should look for this structure and make predictions based on this structure. Our study challenges that and demonstrates that there are some interaction networks that don't have these properties yet are still clearly functional."

"There are a huge number of systems that are composed of interacting parts, and we really don't have a good sense of how these systems are organized," said Blonder. "Think of a city with many people or the Internet with many computers. You have all these parts doing their own thing and somehow achieving some greater function."

The researchers chose to use ant colonies as models for self-directed networks because they are composed of many individual components -- the ants -- with no apparent central organization and yet are able to function as a colony.

"We think no individual ant has a sense of purpose," said Blonder. "It doesn't go out one day and say: 'I'm going to move this pebble for the greater good of the society.' It has a behavioral program where if it sees a pebble, then it's likely to move it. The reason that contributes to the good of the colony is an evolutionary argument where the ants' behavior is shaped over thousands or millions of generations."

Dornhaus and Blonder studied colonies of *Temnothorax rugatulus*, an ant species that is common in southern Arizona.

"These ants like to live in little rock crevices such as underneath a rock or in a split in the rock," said Blonder. "The trick is convincing them to go from their nice little home on Mount Lemmon to the lab."

Which raises an interesting question: How does one collect an ant colony?

"It isn't easy," said Blonder. "You get an aspirator, which is a tube with a fine mesh on the end of it so you don't inhale the ants, and you put the tube down in the colony and you suck. And the ants come up and you blow them out into a container to transport them to the lab."

"Of course, once you flip the rock over, the ants are upset. You have to get them before they all run off somewhere. And you also have to get the queen because without the queen the colony will die."

The queen, the mother ultimatum among ants, is the only member of the colony that reproduces. Without her, there would be no new ant workers and the colony would die.

"There is evidence that the queen secretes a chemical that makes the other workers recognize that she is the queen," said Blonder. "But there's not much evidence for the queen communicating with the workers in ways beyond that."

Back in the lab, the ants were placed in artificial nests. "The nice thing about this species is that because they like to live in rock crevices, they're also completely happy to live between glass slides. All we have to do is take two large glass slides, put a cardboard spacer in between them and the ants happily walk into that very nice thin space and live out their lives in this artificial nest," said Blonder.

Having secured and relocated several ant colonies, the researchers tackled their second challenge: How to tell two ants apart.

"To understand an interaction network, you need to know who all the individuals are," said Blonder. "You need to be able to tell any two individuals apart. We accomplished it by painting each ant with a unique color code."

The researchers filmed the ants with high-definition video and recorded roughly 9,000 interactions between 300 to 400 individual ants. "We watched every single video repeatedly to make sure we didn't miss any interactions and correctly identified every ant," said Blonder.

Dornhaus and Blonder recorded every interaction that involved one ant touching another. "We didn't use visual interactions in this study, and that gave us some ability to standardize," said Blonder. "There could be many more meaningless visual interactions than meaningless touch interactions because touch definitely conveys some chemical data about the other ant."

While the ants do have limited vision, it's thought that most of their sensory input comes through direct chemosensory touch.

Ants antennate, or touch each other with their antennae, for a variety of reasons such as to get another ant to move out of the way, to prod a particularly lazy individual into action or to solicit food. "Not all ants go out and forage for food," said Blonder. "Often the ants that forage will have whatever they found in their guts and food is transferred from one ant's stomach through mouth-to-mouth contact to the other ant. It's called trophallaxis."

Contrary to predictions that ant networks would spread information efficiently in the same way as other self-directed networks, the researchers found that the ants actually are inefficient at spreading information.

The finding challenges the notion of six degrees of separation, the idea that all individuals in a network are related by six other individuals. For example, I know someone who knows someone who knows someone and so on, and by the sixth person or less I am connected to every person in the world.

This would represent a very efficient network, where it only takes six interactions for information to spread to all of the components. Ant interaction networks apparently function quite differently, indicating that other networks also might not be as efficient as previously thought.

"You could come up with a second simple expectation about how ants might behave," said Blonder. "They could be just walking around completely randomly bumping into each other. We were able to show that the real ants consistently had rates of information flow that were lower than even that expectation. Not only are they not efficient, they're also slower than random. They're actually avoiding each other."

"So this raises a big question: If you have this ant colony that is presumably very good at surviving and persisting, and there are a lot of good reasons to think it's optimal to get messages from one part to the other, how come they don't do it?"

One possible explanation is a concept most of us already are familiar with: "If you spend too much time interacting, then you're not actually getting anything done," said Blonder.

Another possibility is that individual ants are responsible for only their region and only need to communicate with other ants in that region.

The research also illustrates the importance of knowing when interactions occur. If two individuals interact and later one of them interacts with a third, then information from the first interaction could be passed to the third individual, but the third individual could not relay information back to the first. "That's the ordering of events perspective that we're bringing to this study and we're hoping is going to catch on with other network studies. We think this is a real opportunity," said Blonder.

"In some contexts it's clearly better not to spread information as quickly and then the question becomes understanding in what context it's good to be efficient and in what context it's not good to be efficient."

Understanding how interaction networks function could have applications from allowing us to build self-directed networks to perform specific functions, such as unmanned drones to explore other planets, to preventing the spread of disease.

"Many of these ant species have been on the planet for millions of years, so clearly they're doing something right," said Blonder. "Perhaps we could learn from that."

Doctoral candidate Tuan Cao and undergraduate students Milan Curry, Han Jing, Kayla Lauger and Daniel Wolf assisted with this study.

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 Shelley Littin.

Journal Reference:

1. Benjamin Blonder, Anna Dornhaus. **Time-Ordered Networks Reveal Limitations to Information Flow in Ant Colonies**. *PLoS ONE*, 2011; 6 (5): e20298 DOI: 10.1371/journal.pone.0020298

http://www.sciencedaily.com/releases/2011/05/110523091541.htm

World Record in Ultra-Rapid Data Transmission

Control of the signal levels: Professor Jürg Leuthold. (Credit: Photo by Gabi Zachmann)

ScienceDaily (May 23, 2011) — Scientists at Karlsruhe Institute of Technology (KIT) have succeeded in encoding data at a rate of 26 terabits per second on a single laser beam, transmitting the data over a distance of 50 kilometers, and decoding the information successfully. This is the largest data volume ever transported on a laser beam. The process developed by KIT enables the transmission of 700 DVDs' worth of content in just one second.

The advance is reported in the journal *Nature Photonics*.

In this experiment, KIT scientists led by Professor Jürg Leuthold beat their own record in high-speed data transmission of 2010, when they exceeded the magic limit of 10 terabits per second -- i.e. a data rate of 10,000 billion bits per second. This success of the group is due to a new data decoding process. The opto-electric decoding method is based on initially purely optical calculation at highest data rates in order to break down the high data rate to smaller bit rates that can then be processed electrically. The initially optical reduction of the bit rates is required, as no electronic processing methods are available for a data rate of 26 terabits per second. Leuthold's team applies the so-called orthogonal frequency division multiplexing (OFDM) for record data encoding. For many years, this process has been used successfully in mobile communications, based on mathematical routines (Fast Fourier Transformation).

"The challenge was to increase the process speed not only by a factor of 1,000, but by a factor of nearly a million for data processing at 26 terabits per second," explains Leuthold, who heads the Institutes of Photonics and Quantum Electronics and Microstructure Technology at KIT. "The decisive innovative idea was optical implementation of the mathematical routine." Calculation in the optical range turned out to be not only extremely fast, but also highly energy-efficient, because energy is required for the laser and a few process steps only.

"Our result shows that physical limits are not yet exceeded even at extremely high data rates," Leuthold says, noting the constantly growing data volume on the internet. According to Leuthold, transmission of 26 terabits per second confirms that even high data rates can be handled today, while energy consumption is minimized. "A few years ago, data rates of 26 terabits per second were deemed utopian even for systems with many lasers." Leuthold adds, "and there would not have been any applications. With 26 terabits per second, it would have been possible to transmit up to 400 million telephone calls at the same time. Nobody needed this at that time. Today, the situation is different."

Video transmissions consume much Internet bandwidth and require extremely high bit rates. The need is growing constantly. In communication networks, first lines with channel data rates of 100 gigabits per second (corresponding to 0.1 terabit per second) have already been taken into operation. Research now concentrates

on developing systems for transmission lines in the range of 400 Gigabits/s to 1 Tbit/s. Hence, the Karlsruhe invention is ahead of the ongoing development. Companies and scientists from all over Europe were involved in the experimental implementation of ultra-rapid data transmission at KIT. Among them were members of the staff of Agilent and Micram Deutschland, Time-Bandwidth Switzerland, Finisar Israel, and the University of Southampton in Great Britain.

Story Source:

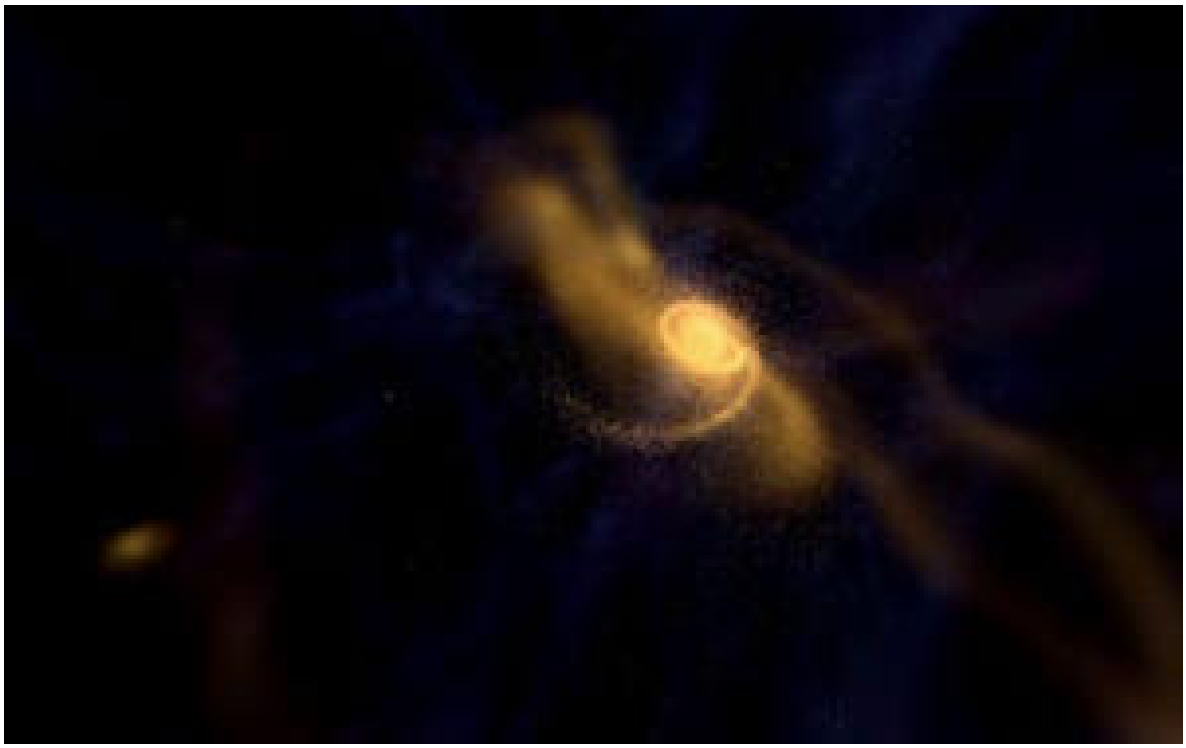
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Karlsruhe Institute of Technology**.

Journal Reference:

1. D. Hillerkuss, R. Schmogrow, T. Schellinger, M. Jordan, M. Winter, G. Huber, T. Vallaitis, R. Bonk, P. Kleinow, F. Frey, M. Roeger, S. Koenig, A. Ludwig, A. Marculescu, J. Li, M. Hoh, M. Dreschmann, J. Meyer, S. Ben Ezra, N. Narkiss, B. Nebendahl, F. Parmigiani, P. Petropoulos, B. Resan, A. Oehler, K. Weingarten, T. Ellermeyer, J. Lutz, M. Moeller, M. Huebner, J. Becker, C. Koos, W. Freude, J. Leuthold. **26 Tbit s−1 line-rate super-channel transmission utilizing all-optical fast Fourier transform processing**. *Nature Photonics*, 2011; DOI: 10.1038/NPHOTON.2011.74

http://www.sciencedaily.com/releases/2011/05/110523101741.htm

Just Four Percent of Galaxies Have Neighbors Like the Milky Way



This image, taken from a visualization created by the Advanced Visualization Laboratory at the National Center for Supercomputing Applications (NCSA), shows the formation of the Milky Way galaxy at 16 million to 13.7 billion years old. Brian O'Shea of Michigan State University (formerly of Los Alamos National Laboratory) and Michael Norman of the University of California at San Diego collaborated on this research. (Credit: National Center for Supercomputing Applications)

ScienceDaily (May 23, 2011) — How unique is the Milky Way?

To find out, a group of researchers led by Stanford University astrophysicist Risa Wechsler compared the Milky Way to similar galaxies and found that just four percent are like the galaxy Earth calls home.

"We are interested in how the Milky Way fits into the broader context of the universe," said Wechsler. "This research helps us understand whether our galaxy is typical or not, and may provide clues to its formation history."

The research team compared the Milky Way to similar galaxies in terms of luminosity--a measure of how much light is emitted--and distance to other bright galaxies. They found galaxies that have two satellites that are as bright and close by as the Milky Way's two closest satellites, the Large and Small Magellanic Clouds, are rare.

Published in the May 20 issue of the *Astrophysical Journal*, the findings are based on analyses of data collected from the Sloan Digital Sky Survey (SDSS). The work is the first of three papers that study the properties of the Milky Way's two most massive satellites.

Supported in part by the National Science Foundation (NSF), the SDSS is the most extensive survey of the optical sky performed to date.

In more than eight years of operations, SDSS has obtained images covering more than a quarter of the sky, and created 3-dimensional maps containing more than 930,000 galaxies and 120,000 quasars. For this analysis, Wechsler's group studied more than 20,000 galaxies with properties similar to the Milky Way and investigated the galaxies surrounding these Milky Way "twins," to create a "census" of galaxies similar to the Milky Way in the universe.

The work represents one of the most extensive studies of this kind ever performed.

Scientists can also compare the SDSS data to galaxies simulated by a computer model. Since they are currently unable to see all the way back to the Big Bang, this is one way researchers are trying to understand how the universe as we see it today began.

In order to learn more about possible conditions in the early universe, the group performed computer simulations to recreate the universe from specific sets of starting conditions. Then they compared their simulations to the SDSS data set. In this way, the group was able to test different theories of galaxy formation to determine whether or not each would result in a universe that matches what we see today. The results of their simulation matched the result found in the SDSS data set: just four percent of the simulated galaxies had two satellites like the Magellanic Clouds.

"This is an excellent example of data-enabled science," said Nigel Sharp, of NSF's Division of Astronomical Sciences. "Comparing the 'fake' and 'real' Universes is how we discriminate between successful and unsuccessful theories. This work interconnects three of the four legs of science: theory, observation and simulation, for a powerful scientific result."

Their results also lend support to a leading theory of galaxy formation called the Cold Dark Matter (CDM) theory. This theory provides what many consider to be the simplest explanation for the arrangement of galaxies throughout the universe following the Big Bang. It assumes that most of the matter in the Universe consists of material that cannot be observed by its electromagnetic radiation (dark) and whose constituent particles move slowly (cold). Dark matter, an invisible and exotic material of unknown composition, is believed to influence the distribution of galaxies in space and the overall expansion of the universe. The rareness of this aspect of the Milky Way may provide clues to its formation history.

"Because the presence of two galaxies like the Magellanic Clouds is unusual, we can use them to learn more about our own galaxy," said Wechsler. Using their simulation, the team identified a sample of simulated galaxies that had satellites matching the Milky Way's in terms of their locations and speeds.

"The combination of large surveys of the sky like the SDSS and large samples of simulated galaxies provides a new opportunity to learn about the place of our galaxy in the Universe," said Wechsler. "Future surveys will allow us to extend this study to even dimmer satellite galaxies, to build a full picture of the formation of our galaxy."

The theoretical and numerical work that produced the simulations used as a comparison for the SDSS data were supported by an award funded under the American Recovery and Reinvestment Act of 2009.

Story Source:

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

Journal Reference:

1. Lulu Liu, Brian F. Gerke, Risa H. Wechsler, Peter S. Behroozi, Michael T. Busha. **How Common Are the Magellanic Clouds?** *The Astrophysical Journal*, 2011; 733 (1): 62 DOI: 10.1088/0004-637X/733/1/62

http://www.sciencedaily.com/releases/2011/05/110523124206.htm

Mummies Tell History of a 'Modern' Plague

The analysis provides the first details about the prevalence of the disease across populations in ancient times. (Credit: Photo by Dennis Van Gerven)

ScienceDaily (May 23, 2011) — Mummies from along the Nile are revealing how age-old irrigation techniques may have boosted the plague of schistosomiasis, a water-borne parasitic disease that infects an estimated 200 million people today.

An analysis of the mummies from Nubia, a former kingdom that was located in present-day Sudan, provides details for the first time about the prevalence of the disease across populations in ancient times, and how human alteration of the environment during that era may have contributed to its spread.

The American Journal of Physical Anthropology is publishing the study, led by Emory graduate student Amber Campbell Hibbs, who recently received her PhD in anthropology. About 25 percent of mummies in the study dated to about 1,500 years ago were found to have Schistosoma mansoni, a species of schistosomiasis associated with more modern-day irrigation techniques.

"Often in the case of prehistoric populations, we tend to assume that they were at the mercy of the environment, and that their circumstances were a given," says Campbell Hibbs. "Our study suggests that, just like people today, these ancient individuals were capable of altering the environment in ways that impacted their health."

The study was co-authored by Emory anthropologist George Armelagos; William Secor, an epidemiologist at the Centers for Disease Control and Prevention; and Dennis Van Gerven, an anthropologist at the University of Colorado at Boulder.

"We hope that understanding the impact of schistosomiasis in the past may help in finding ways to control what is one of the most prevalent parasitic diseases in the world today," Campbell Hibbs says.

Schistosomiasis is caused by parasitic worms that live in certain types of freshwater snails. The parasite can emerge from the snails to contaminate fresh water, and then infect humans whose skin comes in contact with the water.

Infection can cause anemia and chronic illness that impairs growth and cognitive development, damages organs, and increases the risk for other diseases. Along with malaria, schistosomiasis ranks among the most socio-economically damaging parasitic diseases in the world.

As far back as the 1920s, evidence of schistosomiasis was detected in mummies from the Nile River region, but only in recent years did the analysis of the antigens and antibodies of some of the individuals become possible.

This latest study tested desiccated tissue samples from two Nubian populations for S. mansoni. The Kulubnarti population lived about 1,200 years ago, during an era when Nile flooding was at its highest average known height, and archaeological evidence for irrigation is lacking. The Wadi Halfa population lived further south along the Nile, about 1,500 years ago, when the average heights of the river were lower. Archeological evidence indicates that the Wadi Halfa used canal irrigation to sustain multiple crops.

The analysis of tissue samples showed that 25 percent of the Wali Halfi population in the study were infected with S. mansoni, while only 9 percent of the Kulubnarti were infected.

The standing water collected by irrigation canals is particularly favorable to the type of snail that spreads the S. mansoni infection. Another form of the disease, Schistosoma haematobium, is spread by snails that prefer to live in more oxygenated, free-flowing water.

"Previously, it was generally assumed that in ancient populations schistosomiasis was primarily caused by S. haematobium, and that S. mansoni didn't become prevalent until Europeans appeared on the scene and introduced intensive irrigation schemes," Campbell Hibbs says. "That's a sort of Euro-centric view of what's going on in Africa, assuming that more advanced technology is needed to control the elements, and that irrigation conducted in a more traditional way doesn't have a big influence on the environment."

Co-author George Armelagos is a bioarcheologist who has been studying ancient Nubian populations for more than three decades. Through extensive analysis, he and colleagues have shown that nearly 2,000 years ago the Nubians were regularly consuming tetracycline, most likely in their beer, at levels high enough to show they were deliberately brewing the antibiotic effects.

"The Nubians were probably in healthier shape than many other populations of their time, due to the dry climate, which would reduce their bacterial load, and because they were getting tetracycline," Armelagos says. "But the prevalence of schistosomiasis shown in this study suggests that their parasite load was probably quite heavy."

Story Source:

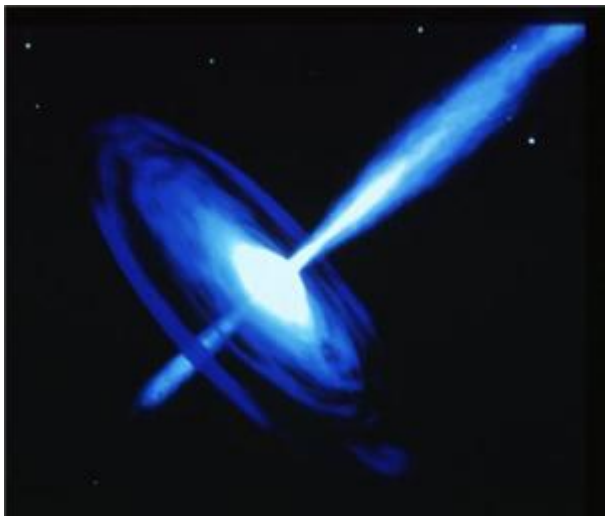
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Emory University**. The original article was written by Carol Clark.

Journal Reference:

1. Amber Campbell Hibbs, W. Evan Secor, Dennis Van Gerven, George Armelagos. **Irrigation and infection: The immunoepidemiology of schistosomiasis in ancient Nubia**. *American Journal of Physical Anthropology*, 2011; DOI: 10.1002/ajpa.21493

http://www.sciencedaily.com/releases/2011/05/110523124210.htm

Black Holes Spin Faster and Faster



An artist's impression of the jets emerging from a supermassive black hole at the centre of the galaxy PKS 0521-36. (Credit: Dana Berry / STScI)

ScienceDaily (May 23, 2011) — Two UK astronomers have found that the giant black holes in the centre of galaxies are on average spinning faster than at any time in the history of the Universe. Dr Alejo Martinez-Sansigre of the University of Portsmouth and Prof. Steve Rawlings of the University of Oxford made the new discovery by using radio, optical and X-ray data. They publish their findings in the journal Monthly Notices of the Royal Astronomical Society.

There is strong evidence that every galaxy has a black hole in its centre. These black holes have masses of between a million and a billion Suns and so are referred to as 'supermassive'. They cannot be seen directly, but material swirls around the black hole in a so-called accretion disk before its final demise. That material can become very hot and emit radiation including X-rays that can be detected by space-based telescopes whilst associated radio emission can be detected by telescopes on the ground.

As well as radiation, twin jets are often associated with black holes and their accretion disks. There are many factors that can cause these jets to be produced, but the spin of the supermassive black hole is believed to be important. However, there are conflicting predictions about how the spins of the black holes should be evolving and until now this evolution was not well understood.

Dr Martinez-Sansigre and Professor Rawlings compared theoretical models of spinning black holes with radio, optical and X-ray observations made using a variety of instruments and found that the theories can explain very well the population of supermassive black holes with jets.

Using the radio observations, the two astronomers were able to sample the population of black holes, deducing the spread of the power of the jets. By estimating how they acquire material (the accretion process) the two scientists could then infer how quickly these objects are spinning.

The observations also give information on how the spins of supermassive black holes have evolved. In the past, when the Universe was half its the present size, practically all of the supermassive black holes had very low spins, whereas nowadays a fraction of them have very high spins. So on average, supermassive black holes are spinning faster than ever before.

This is the first time that the evolution of the spin of the supermassive black holes has been constrained and it suggests that those supermassive black holes that grow by swallowing matter will barely spin, while those that merge with other black holes will be left spinning rapidly.

Commenting on the new results, Dr Martinez-Sansigre said: "The spin of black holes can tell you a lot about how they formed. Our results suggest that in recent times a large fraction of the most massive black holes have somehow spun up. A likely explanation is that they have merged with other black holes of similar mass, which is a truly spectacular event, and the end product of this merger is a faster spinning black hole."

Professor Rawlings adds: "Later this decade we hope to test our idea that these supermassive black holes have been set spinning relatively recently. Black hole mergers cause predictable distortions in space and time -- so-called gravitational waves. With so many collisions, we expect there to be a cosmic background of gravitational waves, something that will change the timing of the pulses of radio waves that we detect from the remnants of massive stars known as pulsars.

If we are right, this timing change should be picked up by the Square Kilometre Array, the giant radio observatory due to start operating in 2019."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Royal Astronomical Society (RAS)**.

Journal Reference:

1. Alejo Martinez-Sansigre and Steve Rawlings. **Observational constraints on the spin of the most massive black holes from radio observations**. *Monthly Notices of the Royal Astronomical Society*, 2011 (in press) [link]

http://www.sciencedaily.com/releases/2011/05/110523074954.htm

Gulf Currents Primed Bacteria to Degrade Oil Spill

Oil washing on shore in Bay St. Louis, MS. (Credit: iStockphoto/Chad Purser)

ScienceDaily (May 23, 2011) — A new computer model of the Gulf of Mexico in the period after the 2010 oil spill provides insights into how underwater currents may have primed marine microorganisms to degrade the oil.

"It is called dynamic auto-inoculation. Parcels of water move over the ruptured well, picking up hydrocarbons. When these parcels come back around and cross back over the well, the bacteria have already been activated, are more abundant than before, and degrade hydrocarbons far more quickly," says David Valentine of the University of California, Santa Barbara, speaking May 22 at the 111th General Meeting of the American Society for Microbiology.

Valentine has been studying microbial communities and the fate of chemicals 4000 feet below the surface from the Deepwater Horizon oil spill since June of 2010. Valentine and his colleagues at UC Santa Barbara, the University of Rijeka in Croatia, and the Naval Research Laboratory recently developed a computer simulation by coupling the Naval Research Laboratory's physical oceanographic model with their own discoveries and knowledge of the microbes responsible for breaking down the chemicals.

"We took the physical model of the deep Gulf of Mexico, added the hydrocarbons and bacteria, set reasonable guidelines for metabolism, and let them eat starting at day 1 of the spill," says Valentine.

To confirm that the model was providing them with an accurate picture of what had happened they compared the model to spot measurements they and others had previously made in the Gulf.

"The model predicts the kinds of distributions observed at different times and locations. The assumptions that went into the model appear to be reasonable," says Valentine.

The most interesting observation they found using the model was dynamic auto-inoculation. Many parcels of water circulated in and out of the source area. Each iteration allowed the bacterial populations to increase in number and degrade the chemicals more rapidly.

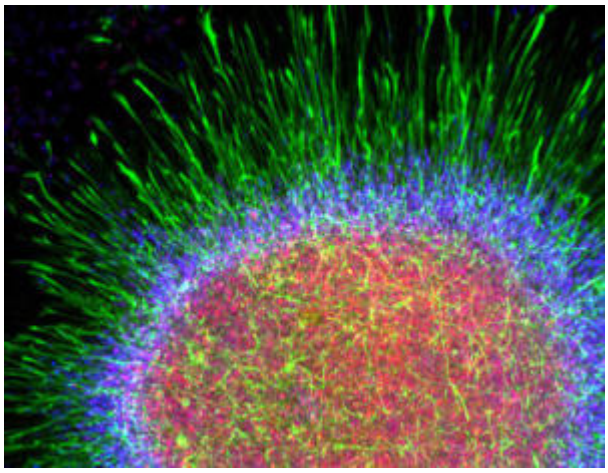
"The more recirculation you have, the more quickly the hydrocarbons will be consumed," says Valentine. "We have developed a model that combines the large-scale movement of the water with the metabolism of the microbes. From that we are observing a phenomenon that molded the distribution of the bacteria over time and space, and that are consistent with real-world observations in the Gulf of Mexico."

Story Source:

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

http://www.sciencedaily.com/releases/2011/05/110522141623.htm

Human Brain's Most Ubiquitous Cell Cultivated in Lab Dish



Astrocytes are star-shaped cells that are the most common cell in the human brain and have now been grown from embryonic and induced stem cells in the laboratory of UW-Madison neuroscientist Su-Chun Zhang. Once considered mere putty or glue in the brain, astrocytes are of growing interest to biomedical research as they appear to play key roles in many of the brain's basic functions, as well as neurological disorders ranging from headaches to dementia. In this picture astrocyte progenitors and immature astrocytes cluster to form an "astrosphere." The work was conducted at UW-Madison's Waisman Center. (Credit: Robert Krencik/ UW-Madison)

ScienceDaily (May 23, 2011) — Pity the lowly astrocyte, the most common cell in the human nervous system. Long considered to be little more than putty in the brain and spinal cord, the star-shaped astrocyte has found new respect among neuroscientists who have begun to recognize its many functions in the brain, not to mention its role in a range of disorders of the central nervous system.

Now, writing in the May 22 issue of the journal *Nature Biotechnology*, a group led by University of Wisconsin-Madison stem cell researcher Su-Chun Zhang reports it has been able to direct embryonic and induced human stem cells to become astrocytes in the lab dish.

The ability to make large, uniform batches of astrocytes, explains Zhang, opens a new avenue to more fully understanding the functional roles of the brain's most commonplace cell, as well as its involvement in a host of central nervous system disorders ranging from headaches to dementia. What's more, the ability to culture the cells gives researchers a powerful tool to devise new therapies and drugs for neurological disorders.

"Not a lot of attention has been paid to these cells because human astrocytes have been hard to get," says Zhang, a researcher at UW-Madison's Waisman Center and a professor of neuroscience in the UW-Madison School of Medicine and Public Health. "But we can make billions or trillions of them from a single stem cell."

Although astrocytes have gotten short shrift from science compared to neurons, the large filamentous cells that process and transmit information, scientists are turning their attention to the more common cells as their roles in the brain become better understood. There are a variety of astrocyte cell types and they perform such basic housekeeping tasks as helping to regulate blood flow, soaking up excess chemicals produced by interacting neurons and controlling the blood-brain barrier, a protective filter that keeps dangerous molecules from entering the brain.

Astrocytes, some studies suggest, may even play a role in human intelligence given that their volume is much greater in the human brain than any other species of animal.

"Without the astrocyte, neurons can't function," Zhang notes. "Astrocytes wrap around nerve cells to protect them and keep them healthy. They participate in virtually every function or disorder of the brain."

The ability to forge astrocytes in the lab has several potential practical outcomes, according to Zhang. They could be used as screens to identify new drugs for treating diseases of the brain, they can be used to model disease in the lab dish and, in the more distant future, it may be possible to transplant the cells to treat a variety of neurological conditions, including brain trauma, Parkinson's disease and spinal cord injury. It is possible that astrocytes prepared for clinical use could be among the first cells transplanted to intervene in a neurological condition as the motor neurons affected by the fatal amyotrophic lateral sclerosis, also known as Lou Gehrig's disease, are swathed in astrocytes.

"With an injury or neurological condition, neurons in the brain have to work harder, and doing so they make more neurotransmitters," chemicals that in excess can be toxic to other cells in the brain, Zhang says.

"One idea is that it may be possible to rescue motor neurons by putting normal, healthy astrocytes in the brain," according to Zhang. "These cells are really useful as a therapeutic target."

The technology developed by the Wisconsin group lays a foundation to make all the different species of astrocytes. What's more, it is possible to genetically engineer them to mimic disease so that previously inaccessible neurological conditions can be studied in the lab.

In addition to Zhang, co-authors of the new Nature Biotechnology paper include Robert Krencik, Jason Weick and Zhijian Zhang, all of UW-Madison, and Yan Liu of Fudan University Shanghai Medical School. The work was supported by the ALS Foundation, the National Institute of Neurological Disorders and Stroke, the National Multiple Sclerosis Society, the Bleser Family Foundation and the Busta Family Foundation.

Story Source:

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

Journal Reference:

1. Robert Krencik, Jason P Weick, Yan Liu, Zhi-Jian Zhang, Su-Chun Zhang. **Specification of transplantable astroglial subtypes from human pluripotent stem cells**. *Nature Biotechnology*, 2011; DOI: 10.1038/nbt.1877

http://www.sciencedaily.com/releases/2011/05/110522141543.htm

Movement Without Muscles: Zoologists on Trail of Evolution of Body Contractions

The sponge Tethya wilhelma has become a model organism for evolutionary questions. (Credit: Photo by Michael Nickel/FSU Jena)

ScienceDaily (May 23, 2011) — All animals move -- cheetahs faster, snails more slowly. Muscle contractions are the basis of movement in many, but not all, species. Some animal groups don't have any muscles at all, as they branched off from the evolutionary path before muscle cells evolved. Yet these animal groups -- for instance, the sea sponges -- are not incapable of movement. Sponges are able to contract without muscles. But which cells in sponges are actually contracting?

A group of scientists headed by associate professor Dr. Michael Nickel of Friedrich Schiller University Jena (Germany) is looking into movement without muscles. The scientists from the Institute of Systematic Zoology and Evolutionary Biology are especially interested in the question of which evolutionary forerunners did muscle cells derive from.

In a new study published in the *Journal of Experimental Biology*, the evolutionary biologists are offering new answers to this question. In their paper, the researchers described how they generated three-dimensional (3-D) images, with the help of synchrotron radiation-based X-ray microtomography. Using this technique, the Jena scientists, in co-operation with the Helmholtz-Zentrum Gesthacht at the Deutsches Elektronen Synchrotron Hamburg, were able to compare and visualize the 3-D structure of contracted and expanded sponges.

"A key feature of our approach is the use of 3-D data for measuring the volume and surface of our sponges," says Nickel. "Although the 3-D volumetric analysis is widely known and used in the technical sciences, it has rarely been used in zoology -- in spite of its enormous information potential."

Nickel's team was able to show that the inner and outer surfaces -- and therefore the epithelial cells, so-called pinacozytes -- cause the strong body contractions of the sponges. Ultimately, the Jena scientists believe they have also settled a hundred-year-old debate about the cause of cellular contractions. Until recently, spindle-shaped cells in the tissue of sponges as well as epithelial cells were thought to be possible candidates. But now, the Jena scientists have been able to identify the true initiator of the contractions.

These findings offer new approaches to understanding the evolutionary development of musculature. "The early evolution of muscles has not been fully understood so far. According to current scientific knowledge, muscle cells seem to have surfaced from nowhere," Nickel says. "But surely there must have been evolutionary predecessor systems, that have been unknown until now." The sponge epithelial cells are now moving to the forefront in the evolutionary biologists' continuing research in this field. "There is a lot of

evidence that the sponge epithelial cells and the muscle cells of all the other animals are going back to a common contractile cellular predecessor." In future, scientists hope to test this hypothesis using genome and gene expression-related data.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Friedrich-Schiller-Universitaet Jena**.

Journal Reference:

1. M. Nickel, C. Scheer, J. U. Hammel, J. Herzen, F. Beckmann. **The contractile sponge epithelium sensu lato - body contraction of the demosponge Tethya wilhelma is mediated by the pinacoderm**. *Journal of Experimental Biology*, 2011; 214 (10): 1692 DOI: 10.1242/jeb.049148

http://www.sciencedaily.com/releases/2011/05/110512104212.htm

Novel Artificial Material Could Facilitate Wireless Power

Unique artificial materials should theoretically make it possible to improve the power transfer to small devices, such as laptops or cell phones, or ultimately to larger ones, such as cars or elevators, without wires, researchers say. (Credit: © Borodaev / Fotolia)

ScienceDaily (May 23, 2011) — Electrical engineers at Duke University have determined that unique artificial materials should theoretically make it possible to improve the power transfer to small devices, such as laptops or cell phones, or ultimately to larger ones, such as cars or elevators, without wires.

This advance is made possible by the recent ability to fabricate exotic composite materials known as metamaterials, which are not so much a single substance, but an entire human-made structure that can be engineered to exhibit properties not readily found in nature. In fact, the metamaterial used in earlier Duke studies, and which would likely be used in future wireless power transmission systems, resembles a miniature set of tan Venetian blinds.

Theoretically, this metamaterial can improve the efficiency of "recharging" devices without wires. As power passes from the transmitting device to the receiving device, most if not all of it scatters and dissipates unless the two devices are extremely close together. However, the metamaterial postulated by the Duke researchers, which would be situated between the energy source and the "recipient" device, greatly refocuses the energy transmitted and permits the energy to traverse the open space between with minimal loss of power.

"We currently have the ability to transmit small amounts of power over short distances, such as in radio frequency identification (RFID) devices," said Yaroslav Urzhumov, assistant research professor in electrical and computer engineering at Duke's Pratt School of Engineering. "However, larger amounts of energy, such as that seen in lasers or microwaves, would burn up anything in its path.

"Based on our calculations, it should be possible to use these novel metamaterials to increase the amount of power transmitted without the negative effects," Urzhumov said.

The results of the Duke research were published online in the journal *Physical Review B*. Urzhumov works in the laboratory of David R. Smith, William Bevan Professor of electrical and computer engineering at Pratt School of Engineering. Smith's team was the first demonstrate that similar metamaterials could act as a cloaking device in 2006.

Just as the metamaterial in the cloaking device appeared to make a volume of space "disappear," in the latest work, the metamaterial would make it seem as if there was no space between the transmitter and the recipient, Urzhumov said. Therefore, he said, the loss of power should be minimal.

Urzhumov's research is an offshoot of "superlens" research conducted in Smith's laboratory. Traditional lenses get their focusing power by controlling rays as they pass through the two outside surfaces of the lens. On the other hand, the superlens, which is in fact a metamaterial, directs waves within the bulk of the lens between the outside surfaces, giving researchers a much greater control over whatever passes through it.

The metamaterial used in wireless power transmission would likely be made of hundreds to thousands -- depending on the application -- of individual thin conducting loops arranged into an array. Each piece is made from the same copper-on-fiberglass substrate used in printed circuit boards, with excess copper etched away. These pieces can then be arranged in an almost infinite variety of configurations.

"The system would need to be tailored to the specific recipient device, in essence the source and target would need to be 'tuned' to each other," Urzhumov said. "This new understanding of how matematerials can be fabricated and arranged should help make the design of wireless power transmission systems more focused."

The analysis performed at Duke was inspired by recent studies at Mitsubishi Electric Research Labs (MERL), an industrial partner of the Duke Center for Metamaterials and Integrated Plasmonics. MERL is currently investigating metamaterials for wireless power transfer. The Duke researchers said that with these new insights into the effects of metamaterials, developing actual devices can be more targeted and efficient.

The Duke University research was supported by a Multidisciplinary University Research Initiative (MURI) grant through the Air Force Office of Scientific Research and the U.S. Army Research Office.

Story Source:

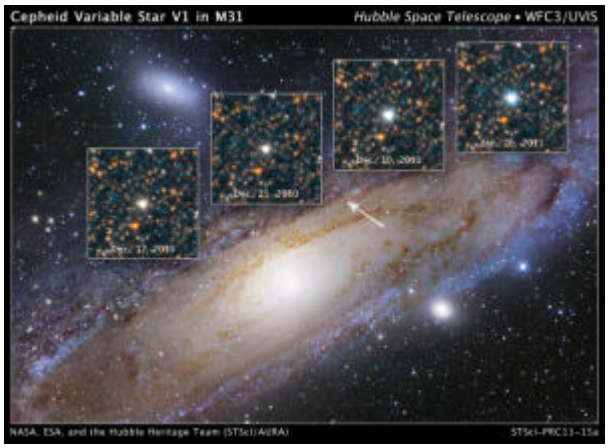
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Duke University**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Yaroslav Urzhumov, David Smith. **Metamaterial-enhanced coupling between magnetic dipoles for efficient wireless power transfer**. *Physical Review B*, 2011; 83 (20) DOI: 10.1103/PhysRevB.83.205114

http://www.sciencedaily.com/releases/2011/05/110523124218.htm

Hubble Views the Star That Changed the Universe



NASA's Hubble Space Telescope has been trained on a single variable star that in 1923 altered the course of modern astronomy. V1 is a special class of pulsating star called a Cepheid variable that can be used to make reliable measurements of large cosmic distances. (Credit: NASA, ESA, and the Hubble Heritage Team (STScI/AURA))

ScienceDaily (May 23, 2011) — Though the universe is filled with billions upon billions of stars, the discovery of a single variable star in 1923 altered the course of modern astronomy. And, at least one famous astronomer of the time lamented that the discovery had shattered his world view.

The star goes by the inauspicious name of Hubble variable number one, or V1, and resides in the outer regions of the neighboring Andromeda galaxy, or M31. But in the early 1900s, most astronomers considered the Milky Way a single "island universe" of stars, with nothing observable beyond its boundaries. Andromeda was cataloged as just one of many faint, fuzzy patches of light astronomers called "spiral nebulae."

Were these spiral nebulae part of the Milky Way or were they independent island universes lying outside our galaxy? Astronomers didn't know for sure, until Edwin Hubble found a star in Andromeda that brightened and faded in a predictable pattern, like a lighthouse beacon, and identified it as V1, a Cepheid variable. This special type of star had already been proven to be a reliable distance marker within our galaxy.

The star helped Hubble show that Andromeda was beyond our galaxy and settled the debate over the status of the spiral nebulae. The universe became a much bigger place after Hubble's discovery, much to the dismay of astronomer Harlow Shapley, who believed the fuzzy nebulae were part of our Milky Way.

Nearly 90 years later, V1 is in the spotlight again. Astronomers pointed Edwin Hubble's namesake, NASA's Hubble Space Telescope, at the star once again, in a symbolic tribute to the legendary astronomer's milestone observation.

Astronomers with the Space Telescope Science Institute's Hubble Heritage Project partnered with the American Association of Variable Star Observers (AAVSO) to study the star. AAVSO observers followed V1 for six months, producing a plot, or light curve, of the rhythmic rise and fall of the star's light. Based on this light curve, the Hubble Heritage team scheduled telescope time to capture images of the star.

"V1 is the most important star in the history of cosmology," says astronomer Dave Soderblom of the Space Telescope Science Institute (STScI) in Baltimore, Md., who proposed the V1 observations.

"It's a landmark discovery that proved the universe is bigger and chock full of galaxies. I thought it would be nice for the Hubble telescope to look at this special star discovered by Hubble, the man."

But Hubble Heritage team member Max Mutchler of the STScI says that this observation is more than just a ceremonial nod to a famous astronomer.

"This observation is a reminder that Cepheids are still relevant today," he explains. "Astronomers are using them to measure distances to galaxies much farther away than Andromeda. They are the first rung on the cosmic distance ladder."

The Hubble and AAVSO observations of V1 were presented at a press conference May 23 at the American Astronomical Society meeting in Boston, Mass.

Ten amateur astronomers from around the world, along with AAVSO Director Arne Henden, made 214 observations of V1 between July 2010 and December 2010. They obtained four pulsation cycles, each of which lasts more than 31 days. The AAVSO study allowed the Hubble Heritage team to target Hubble observations that would capture the star at its brightest and dimmest phases.

The observations were still tricky, though. "The star's brightness has a gradual decline followed by a sharp spike upward, so if you're off by a day or two, you could miss it," Mutchler explains.

Using the Wide Field Camera 3, the team made four observations in December 2010 and January 2011.

"The Hubble telescope sees many more and much fainter stars in the field than Edwin Hubble saw, and many of them are some type of variable star," Mutchler says. "Their blinking makes the galaxy seem alive. The stars look like grains of sand, and many of them have never been seen before."

For Soderblom, the Hubble observations culminated more than 25 years of promoting the star. Shortly after Soderblom arrived at the Institute in 1984, he thought it would be fitting to place a memento of Edwin Hubble's aboard the space shuttle Discovery, which would carry the Hubble Space Telescope into space.

"At first, I thought the obvious artifact would be his pipe, but [cosmologist] Allan Sandage [Edwin Hubble's protege] suggested another idea: the photographic glass plate of V1 that Hubble made in 1923," Soderblom recalls.

He made 15 film copies of the original 4-inch-by-5-inch glass plate. Ten of them flew onboard space shuttle Discovery in 1990 on the Hubble deployment mission. Fittingly, two of the remaining five film copies were part of space shuttle Atlantis's cargo in 2009 for NASA's fifth servicing mission to Hubble. One of those copies was carried aboard by astronaut and astronomer John Grunsfeld, now the STScI's deputy director.

Telltale Star Expands the Known Universe

Prior to the discovery of V1 many astronomers thought spiral nebulae, such as Andromeda, were part of our Milky Way galaxy. Others weren't so sure. In fact, astronomers Shapley and Heber Curtis held a public debate in 1920 over the nature of these nebulae. During the debate, Shapley championed his measurement of 300,000 light-years for the size of the Milky Way. Though Shapley overestimated its size, he was correct in asserting that the Milky Way was much larger than the commonly accepted dimensions. He also argued that spiral nebulae were much smaller than the giant Milky Way and therefore must be part of our galaxy. But Curtis disagreed. He thought the Milky Way was smaller than Shapley claimed, leaving room for other island universes beyond our galaxy.

To settle the debate, astronomers had to establish reliable distances to the spiral nebulae. So they searched for stars in the nebulae whose intrinsic brightness they thought they understood. Knowing a star's true brightness allowed astronomers to calculate how far away it was from Earth. But some of the stars they selected were not dependable milepost markers.

For example, Andromeda, the largest of the spiral nebulae, presented ambiguous clues to its distance. Astronomers had observed different types of exploding stars in the nebula. But they didn't fully understand the underlying stellar processes, so they had difficulty using those stars to calculate how far they were from Earth. Distance estimates to Andromeda, therefore, varied from nearby to far away. Which distance was correct? Edwin Hubble was determined to find out.

The astronomer spent several months in 1923 scanning Andromeda with the 100-inch Hooker telescope, the most powerful telescope of that era, at Mount Wilson Observatory in California. Even with the sharp-eyed telescope, Andromeda was a monstrous target, about 5 feet long at the telescope's focal plane. He therefore took many exposures covering dozens of photographic glass plates to capture the whole nebula.

He concentrated on three regions. One of them was deep inside a spiral arm. On the night of Oct. 5, 1923, Hubble began an observing run that lasted until the early hours of Oct. 6. Under poor viewing conditions, the astronomer made a 45-minute exposure that yielded three suspected novae, a class of exploding star. He wrote the letter "N," for nova, next to each of the three objects.

Later, however, Hubble made a startling discovery when he compared the Oct. 5-6 plate with previous exposures of the novae. One of the so-called novae dimmed and brightened over a much shorter time period than seen in a typical nova.

Hubble obtained enough observations of V1 to plot its light curve, determining a period of 31.4 days, indicating the object was a Cepheid variable. The period yielded the star's intrinsic brightness, which Hubble then used to calculate its distance. The star turned out to be 1 million light-years from Earth, more than three times Shapley's calculated diameter of the Milky Way.

Taking out his marking pen, Hubble crossed out the "N" next to the newfound Cepheid variable and wrote "VAR," for variable, followed by an exclamation point.

For several months the astronomer continued gazing at Andromeda, finding another Cepheid variable and several more novae. Then Hubble sent a letter along with a light curve of V1 to Shapley telling him of his discovery. After reading the letter, Shapley was convinced the evidence was genuine. He reportedly told a colleague, "Here is the letter that destroyed my universe."

By the end of 1924 Hubble had found 36 variable stars in Andromeda, 12 of which were Cepheids. Using all the Cepheids, he obtained a distance of 900,000 light-years. Improved measurements now place Andromeda at 2 million light-years away.

"Hubble eliminated any doubt that Andromeda was extragalactic," says Owen Gingerich, professor emeritus of Astronomy and of the History of Science at Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass. "Basically, astronomers didn't know the distance to novae, so they had to make a rough estimate as to where they were and therefore what their absolute luminosity was. But that is on very treacherous ground. When you get a Cepheid that's been reasonably calculated, the period will tell you where it sits on the luminosity curve, and from that you can calculate a distance."

Shapley and astronomer Henry Norris Russell urged Hubble to write a paper for a joint meeting of the American Astronomical Society and American Association for the Advancement of Science at the end of

December 1924. Hubble's paper, entitled "Extragalactic Nature of Spiral Nebulae," was delivered in absentia and shared the prize for the best paper. A short article about the award appeared in the Feb. 10, 1925, issue of The New York Times. Gingerich says Hubble's discovery was not big news at the meeting because the astronomer had informed the leading astronomers of his result months earlier.

Edwin Hubble's observations of V1 became the critical first step in uncovering a larger, grander universe. He went on to find many galaxies beyond the Milky Way. Those galaxies, in turn, allowed him to determine that the universe is expanding.

Could Hubble ever have imagined that nearly 100 years later, technological advances would allow amateur astronomers to perform similar observations of V1 with small telescopes in their backyards? Or, could Hubble ever have dreamed that a space-based telescope that bears his name would continue his quest to precisely measure the universe's expansion rate?

For images and more information, visit: http://hubblesite.org/newscenter/archive/releases/2011/15

Story Source:

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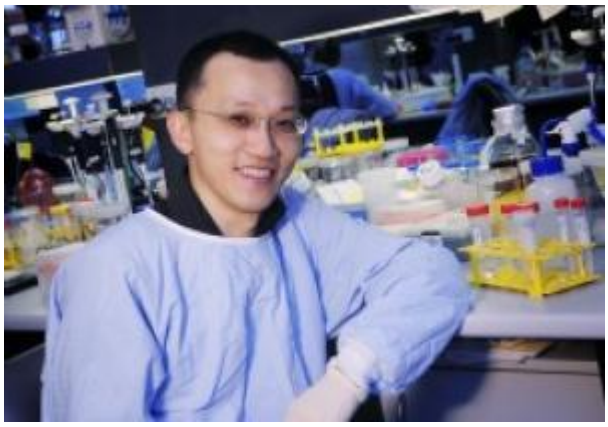
http://www.sciencedaily.com/releases/2011/05/110523171129.htm

Mushroom Compound Suppresses Prostate Tumors



Dr Patrick Ling says this is the first time the PSP compound has been shown to have anti-cancer stem cell effects. (Credit: Image courtesy of Queensland University of Technology)

ScienceDaily (May 22, 2011) — A mushroom used in Asia for its medicinal benefits has been found to be 100 per cent effective in suppressing prostate tumour development in mice during early trials, new Queensland University of Technology (QUT) research shows.

The compound, polysaccharopeptide (PSP), which is extracted from the 'turkey tail' mushroom, was found to target prostate cancer stem cells and suppress tumour formation in mice, according to an article written by senior research fellow Dr Patrick Ling in the online journal *PLoS ONE*, published by the Public Library of Science.

Dr Ling, from the Australian Prostate Cancer Research Centre-Queensland and Institute for Biomedical Health & Innovation (IHBI) at QUT, said the results could be an important step towards fighting a disease that kills 3,000 Australian men a year.

"The findings are quite significant," Dr Ling said.

"What we wanted to demonstrate was whether that compound could stop the development of prostate tumours in the first place.

"In the past, other inhibitors tested in research trials have been shown to be up to 70 per cent effective, but we're seeing 100 per cent of this tumour prevented from developing with PSP.

"Importantly, we did not see any side effects from the treatment."

Dr Ling said conventional therapies were only effective in targeting certain cancer cells, not cancer stem cells, which initiated cancer and caused the disease to progress.

During the research trial, which was done in collaboration with The University of Hong Kong and Provital Pty Ltd, transgenic mice that developed prostate tumours were fed PSP for 20 weeks.

Dr Ling said no tumours were found in any of the mice fed PSP, whereas mice not given the treatment developed prostate tumours. He said the research suggested that PSP treatment could completely inhibit prostate tumour formation.

"Our findings support that PSP may be a potent preventative agent against prostate cancer, possibly through targeting of the prostate cancer stem cell population," he said.

He said PSP had been previously shown to possess anti-cancer properties, and 'turkey tail' mushrooms (known as Coriolus versicolor or Yun-zhi) had been widely used in Asia for medicinal benefits.

However, Dr Ling said it was the first time it had been demonstrated that PSP had anti-cancer stem cell effects.

Although 'turkey tail' mushrooms had valuable health properties, Dr Ling said it would not be possible to get the same benefit his research showed from simply eating them.

A fundraiser has been organised in September to support further tests for the therapeutic potential of PSP against prostate tumours either alone or in combination with other anti-cancer compounds.

Story Source:

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

Journal Reference:

1. Sze-Ue Luk, Terence Kin-Wah Lee, Ji Liu, Davy Tak-Wing Lee, Yung-Tuen Chiu, Stephanie Ma, Irene Oi-Lin Ng, Yong-Chuan Wong, Franky Leung Chan, Ming-Tat Ling. **Chemopreventive Effect of PSP Through Targeting of Prostate Cancer Stem Cell-Like Population**. *PLoS ONE*, 2011; 6 (5): e19804 DOI: 10.1371/journal.pone.0019804

http://www.sciencedaily.com/releases/2011/05/110523091539.htm

Natural Product Shows Pain-Killing Properties

ScienceDaily (May 23, 2011) — Scientists from the Florida campus of The Scripps Research Institute have for the first time accomplished a laboratory synthesis of a rare natural product isolated from the bark of a plant widely employed in traditional medicine. This advance may provide the scientific foundation to develop an effective alternative to commonly prescribed narcotic pain treatments.

The study, published May 23, 2011, in an advanced online edition of the journal *Nature Chemistry*, defines a chemical means to access meaningful quantities of the rare natural product conolidine. Based on data from mouse models, the study also suggests that synthetic conolidine is a potent analgesic as effective as morphine in alleviating inflammatory and acute pain, with few, if any, side effects.

In recent years, there has been significant interest in developing alternatives to opiate-based pain medications such as morphine. While widely prescribed for pain, morphine has a number of adverse side effects that range from the unpleasant to the lethal, including nausea, chronic constipation, addiction, and breathing depression.

The rare natural product central to the study is derived from the bark of a widely grown tropical flowering plant Tabernaemontana divaricata (also known as crepe jasmine). Long part of traditional medicine in China, Thailand, and India, extract from the leaves has been used as an anti-inflammatory applied to wounds, while the root has been chewed to fight the pain of toothache. Other parts of the plant have been used to treat skin diseases and cancer.

Conolidine belongs to a larger class of natural products, called C5-nor stemmadenines, members of which have been described as opioid analgesics, despite a substantial discrepancy between potent in vivo analgesic properties and low affinity to opiate receptors. Conolidine is an exceptionally rare member of this family for which no therapeutically relevant properties had ever been described. Despite the potential value of conolidine and related C5-nor stemmadenines as leads for therapeutics, efficient methods to prepare these molecules were lacking.

"This was a classic problem in chemical synthesis," said Glenn Micalizio, an associate professor in the Department of Chemistry, who initiated and directed the study, "which we were able to solve effectively and efficiently¬¬ -- an achievement that made subsequent assessment of the potential therapeutic properties of this rare natural product possible."

Micalizio and his colleagues began working on the synthesis of the molecule after they arrived at Scripps Florida in 2008.

Testing For Potency

Once the synthesis was complete, research shifted to pharmacology for evaluation. The pharmacological assessment, performed in the laboratory of Scripps Florida Associate Professor Laura Bohn, showed that the new synthetic compound has surprisingly potent analgesic properties.

"Her pharmacological studies confirmed that while it's not an opiate, it's nearly as potent as morphine," Micalizio said.

In various models of pain, the new synthetic compound performed spectacularly, suppressing acute pain and inflammatory-derived pain, two key measures of efficacy. Not only that, but the new compound passed easily through the blood-brain barrier, and was present in the brain and blood at relatively high concentrations up to four hours after injection.

Bohn herself was surprised by the compound's potency and by the fact it so readily enters the brain.

"While the pain-relieving properties are encouraging, we are still challenged with elucidating the mechanism of action," she said. "After pursuing more than 50 probable cellular targets, we are still left without a primary mechanism."

So far, the compound has shown remarkably few, if any, side effects, but that is something of a double-edged sword.

"The lack of side effects makes it a very good candidate for development," Bohn said. "On the other hand, if there were side effects, they might provide additional clues as to how the compound works at the molecular level."

That remains a mystery. While the synthetic compound might be as effective as morphine, it doesn't act at any of the receptors associated with opiates. In fact, it misses most of the major neurotransmitter receptors completely, suggesting it may be highly tuned towards relieving pain while not producing multiple side effects. While still in the early stages of development, further characterizations of conolidine may suggest further development as a human therapeutic for the treatment of pain.

The first author of the study, "Synthesis of Conolidine, a Potent Non-Opioid Analgesic for Tonic and Persistent Pain," is Michael A. Tarselli of Scripps Research. Other authors include Kirsten M. Raehal, Alex K. Brasher, John M. Streicher, Chad Groer, and Michael D. Cameron, also of Scripps Research.

This research was made possible by Scripps Florida start-up funds, resulting from a one-time appropriation of federal economic development funds by the State of Florida, as well as support from Palm Beach County.

Story Source:

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

Journal Reference:

1. Michael A. Tarselli, Kirsten M. Raehal, Alex K. Brasher, John M. Streicher, Chad E. Groer, Michael D. Cameron, Laura M. Bohn, Glenn C. Micalizio. **Synthesis of conolidine, a potent non-opioid analgesic for tonic and persistent pain**. *Nature Chemistry*, 2011; 3 (6): 449 DOI: 10.1038/nchem.1050

http://www.sciencedaily.com/releases/2011/05/110523075316.htm

Weight Gain Between First and Second Pregnancies Increases Woman's Gestational Diabetes Risk, Study Finds

ScienceDaily (May 23, 2011) — Compared with women whose weight remained stable, body mass index gains between the first and second pregnancy were associated with an increased risk of gestational diabetes mellitus in the second pregnancy. But losing weight between the first and second pregnancies appeared to reduce GDM risk in a second pregnancy, particularly for women who were overweight or obese to begin with, according to a Kaiser Permanente Division of Research study appearing online in the journal *Obstetrics and Gynecology.*

GDM is associated with an increased risk of adverse perinatal outcomes as well as subsequent diabetes in women and their offspring, researchers say.

The study examined a diverse cohort of 22,351 women from Kaiser Permanente in Northern California over a 10-year period. Women who gained 2.0-2.9 BMI units (approximately 12 to 17 pounds) between the first and second pregnancy were more than two times more likely to develop GDM in the second pregnancy compared with those whose weight remained stable (plus or minus 6 pounds between pregnancies). Women who gained 3.0 or more BMI units (approximately 18 or more pounds) between the first and second pregnancy were more than three times more likely to develop GDM during the second pregnancy compared with those whose weight remained stable

Conversely, women who lost more than 6 pounds between the first and second pregnancy reduced their risk of developing GDM in the second pregnancy by approximately 50 percent compared with women whose weight remained stable. The association between losing weight and reduced GDM risk was strongest in women who were overweight or obese in their first pregnancy, explained the researchers.

Previous research has shown that excessive postpartum weight retention and lifestyle changes have been associated with a woman being overweight years after pregnancy, which increases the risk of developing non-insulin-dependent diabetes mellitus, said study lead investigator Samantha Ehrlich, MPH, a project manager at the Kaiser Permanente Division of Research in Oakland, Calif. Weight gain before pregnancy and gestational weight gain similarly have been shown to increase the risk of GDM. Additional research has shown that a pregnancy complicated by GDM is associated with a high risk of recurrent GDM in a subsequent pregnancy, explained Ehrlich, who is a PhD candidate in Epidemiology at the University of California at Berkeley.

This study is the first to examine whether weight loss before a second pregnancy reduces the risk of recurrent GDM.

Women who lose BMI between pregnancies appear to have a decreased risk of GDM in their second pregnancy, but there was significant variation by maternal overweight or obese status in the first pregnancy. Weight loss was associated with lower risk of GDM primarily among women who were overweight or obese in their first pregnancy, Ehrlich said.

She explained that being overweight or obese prior to pregnancy is a well-established risk factor for GDM. Women of normal weight who go on to develop GDM are likely to be more genetically susceptible to the disease. Thus, lifestyle changes resulting in weight loss may not be as effective in reducing GDM risk among normal weight women, she added.

"The results also suggest that the effects of body mass gains may be greater among women of normal weight in their first pregnancy, whereas the effects of losses in body mass appear greater among overweight or obese women," Ehrlich said. "Taken together, the results support the avoidance of gestational weight retention and

postpartum weight gain to decrease the risk of GDM in a second pregnancy, as well as the promotion of postpartum weight loss in overweight or obese women, particularly those with a history of GDM."

In the study, BMI units were calculated for the average height of the study population, which was 5 feet 4 inches, and one BMI unit corresponded to approximately 6 pounds.

Co-authors on the study include Monique M. Hedderson, PhD; Juanran Feng, MS; Erica R. Davenport; Erica P Gunderson, PhD; and Assiamira Ferrara, MD, PhD, all with the Kaiser Permanente Division of Research in Oakland, Calif. The study was funded by a grant from the National Institute of Diabetes and Digestive and Kidney Diseases and a community benefit grant from Kaiser Permanente in Northern California.

Story Source:

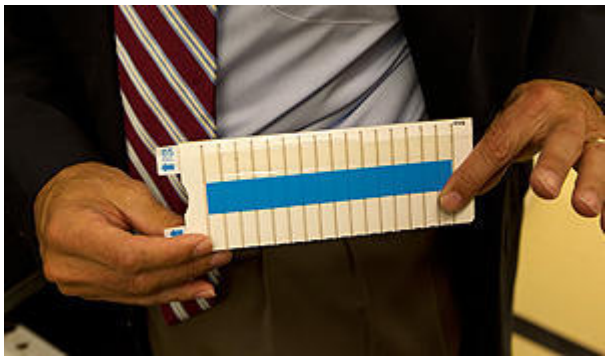
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Kaiser Permanente**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Ehrlich, Samantha F.; Hedderson, Monique M.; Feng, Juanran; Davenport, Erica R.; Gunderson, Erica P.; Ferrara, Assiamira. **Change in Body Mass Index Between Pregnancies and the Risk of Gestational Diabetes in a Second Pregnancy**. *Obstetrics & Gynecology*, 2011; 117 (6): 1323-1330 DOI: 10.1097/AOG.0b013e31821aa358

http://www.sciencedaily.com/releases/2011/05/110523180943.htm

New Device Could Reduce Surgical Scarring



This novel dressing, which Stanford researchers call a "stress-shielding device," helps to eliminates tension that occurs after sutures are removed when the edges of a healing incision are pulled in different directions by the taut, surrounding skin, which causes scar tissue to thicken and spread. (Credit: Norbert von der Groeben)

ScienceDaily (May 23, 2011) — Researchers at Stanford University have developed a special wound dressing that they report was able to significantly reduce scar tissue caused by incisions.

Results of animal tests and of an early clinical trial of the dressing were "stunning," said Michael Longaker, MD, MBA, the Deane P. and Louise Mitchell Professor at the School of Medicine and senior author of a study that details the findings. "It was a surprisingly effective treatment."

The study will be published online May 23 in the *Annals of Surgery.*

After sutures are removed, the edges of a healing incision are pulled in different directions by the taut, surrounding skin, causing scar tissue to thicken and spread. The novel dressing, which the authors refer to as a "stress-shielding device," eliminates this tension and hence a considerable amount of scarring.

"This work actually started 20 years ago when I was an intern at Massachusetts General Hospital," said lead author Geoffrey Gurtner, MD, professor and associate chair of surgery. "I realized early on that we were not going to solve the problem of scarring with current surgical tools and techniques."

Co-author Reinhold Dauskardt, PhD, professor of materials science and engineering in the School of Engineering, recalled a meeting he had with Gurtner that launched the effort to create a stress-shielding device. "We were talking about our respective research," Dauskardt said. "Geoff had a lot of experience in wound healing and was thinking about factors that led to scarring. He said, 'If only we could keep in check the mechanical forces acting on the wound.' I had multiple programs on skin biomechanics and transdermal-drug delivery. I said, 'I think I can do that.'"

Dauskardt and his colleagues created the dressing in his lab. It is made of a thin and elastic silicone plastic that is stretched over the incision after sutures have been removed. The dressing sticks to the skin with the help of an adhesive. As it contracts, it provides uniform compression across the wound.

Scar tissue, which is less flexible than regular skin, can cause functional problems, such as limiting motion. Hair does not grow in a scar, and it doesn't have sweat glands. In addition, scars do not look like regular skin: They are often raised and have a pinkish hue. Many people consider them unattractive. Yet they are an unavoidable side effect of surgery. Every year in the United States, more than 50 million incisions are created during operations. Meanwhile, hundreds of millions of people already have scars that they would prefer to

eliminate. Current scar-removal techniques, including surgical excision, steroid injections and laser therapy, are generally expensive, painful or simply not very effective, the authors say.

The researchers predicted the dressing will be used not only to reduce scarring from incisions, but also to make the surgical revision of existing scars a more appealing option; the second scar would be much less visible, if visible at all.

In pigs, which have skin similar to that of humans, the area of scars caused by roughly 1-inch incisions was reduced six-fold by the stress-shielding device, compared to pigs in a control group with the same-sized incisions, the study said. The stress-shielded wounds "demonstrated nearly scarless closure" eight weeks after sutures had been removed.

The researchers also tested the device on roughly 1-by-1.5-inch excisions -- a wound mimicking the kind caused by scar removal -- and found that "stress shielding dramatically decreased scar area" compared to unshielded wounds of the same size. "The device seemed to promote regenerative-like repair rather than scar formation," the authors wrote.

Next, the researchers tested the device on nine female patients who had undergone abdominoplasties (tummy tucks). Given the quantity of tissue removed during this elective surgery, a tremendous amount of tension occurred across the wound after closure. (Scars from these procedures are typically wide and thick.) Longaker said he and his colleagues deliberately chose to test the dressing on incisions closed with high tension: If the dressing could reduce scarring in such cases, it would surely work on any other kind of incision.

One side of the abdomen-wide incision on each patient was treated with the stress-shielding dressing; the other half was not. A panel of three plastic surgeons unaffiliated with the research, as well as a panel of three people not in the medical profession, acted as judges. On a 100-point scale, the lay panel scored the appearance of stress-shielded wounds an average of 13.2 points higher than the control wounds. The expert panel scored the scar appearance of the treated incisions 39.2 points higher. In both of these analyses, the difference between the treated side and the control side were highly significant, the researchers said.

But they noted that some of the wounds demonstrated more dramatic improvement than others. They speculate this may have been due to differences in the amount of tension present in the dressings when they were applied to the wounds. In any case, the researchers cautioned that this was a preliminary clinical study designed only to show "proof of principle in humans."

"Larger clinical trials are being planned to include greater ethnic diversity within the patient population and to determine the optimal range of stress-shielding forces for anatomic region- and dimension-specific wounds," the authors wrote.

Other co-authors of the paper, all at Stanford, were: Victor Wong, MD, and Kirit Bhatt, MD, postdoctoral research fellows in the Department of Surgery; Kenneth Wu, PhD, a recent postdoctoral scholar in the Department of Materials Science and Engineering; Ivan Vial, a medical student; Karine Padois, PhD, a postdoctoral scholar in the Department of Materials Science and Engineering; and Joshua Korman, MD, an adjunct clinical assistant professor of plastic and reconstructive surgery.

The research was supported by a Wallace H. Coulter Translational Partners Grant; the Armed Forces Institute of Regenerative Medicine; the Hagey Family Endowed Fund in Stem Cell Research and Regenerative Medicine; and the Oak Foundation.

Neodyne Biosciences Inc. provided the special surgical dressings for the study. Gurtner, Dauskardt and Longaker are founders and hold equity in the company.

Story Source:

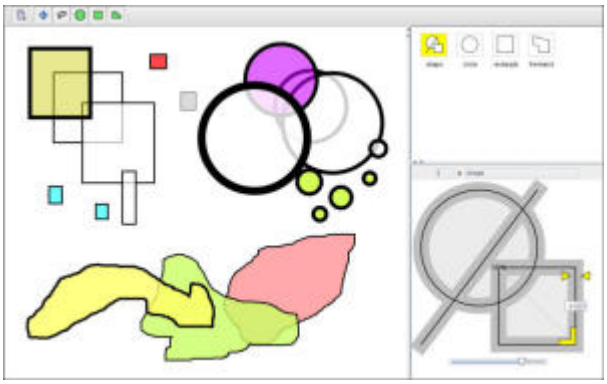
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Stanford University Medical Center**.

Journal Reference:

1. Geoffrey C. Gurtner, Reinhold H. Dauskardt, Victor W. Wong, Kirit A. Bhatt, Kenneth Wu, Ivan N. Vial, Karine Padois, Joshua M. Korman, Michael T. Longaker. **Improving Cutaneous Scar by Controlling the Mechanical Environment**. *Annals of Surgery*, 2011; DOI: 10.1097/SLA.0b013e318220b159

http://www.sciencedaily.com/releases/2011/05/110523075309.htm

'Surrogates' Aid Design of Complex Parts and Controlling Video Games



This graphic illustrates a drawing editor for a new class of software, named "surrogate interaction," a term coined by researchers at Purdue University. The approach enables designers and video gamers to more easily change features of complex objects like automotive drawings or animated characters in video games. (Credit: Purdue University image/Niklas Elmqvist)

ScienceDaily (May 10, 2011) — Researchers have defined a new class of software, calling it "surrogate interaction," which enables designers and video gamers to more easily change features of complex objects like automotive drawings or animated characters.

The new interactive approach is being used commercially and in research but until now has not been formally defined, and doing so could boost its development and number of applications, said Ji Soo Yi, an assistant professor of industrial engineering at Purdue University.

Conventional computer-aided design programs often rely on the use of numerous menus containing hundreds of selection options. The surrogate interaction uses a drawing that resembles the real object to provide users a more intuitive interface than menus.

The Purdue researchers have investigated the characteristics of surrogate interaction, explored potential ways to use it in design applications, developed software to test those uses and suggested the future directions of the research.

Surrogates are interactive graphical representations of real objects, such as a car or a video game character, with icons on the side labeling specific parts of the figure, said Niklas Elmqvist, a Purdue assistant professor of electrical and computer engineering.

"If you click on one label, you change color, if you drag a border you change its width. Anything you do to the surrogate affects the actual objects you are working with," he said. "The way it is now, say I'm working on a car design and wanted to move the rear wheels slightly forward, or I want to change an object's color or thickness of specific parts. I can't make those changes to the drawing directly but have to search in menus and use arcane commands."

Several techniques have been developed over the years to address these issues.

"But they are all isolated and limited efforts with no coherent underlying principle," Elmqvist said. "We propose the notion of surrogate interaction to unify other techniques that have been developed. We believe that formalizing this family of interaction techniques will provide an additional and powerful interface design alternative, as well as uncover opportunities for future research."

The approach also allows video gamers to change attributes of animated characters.

"For computer games, especially role playing games, you may have a warrior character that has lots of different armor and equipment," Elmqvist said. "Usually you can't interact with the character itself. If you want to put in a new cloak or a sword you have to use this complex system of menus."

Research findings are detailed in a paper presented during the Association for Computing Machinery's CHI Conference on Human Factors in Computing Systems through May 12 in Vancouver, British Columbia. The research paper was written by industrial engineering doctoral student Bum chul Kwon, electrical and computer engineering doctoral student Waqas Javed, Elmqvist and Yi.

Kwon and Yi helped theorize the idea of surrogate interaction with relation to previous models of interaction.

The method also makes it possible to manipulate more than one object simultaneously.

"In computer strategy games you might be moving an army or maybe five infantry soldiers, and you want to take a building," Elmqvist said. "Using our technique you would let a surrogate, one soldier, represent all of the soldiers. Any commands you issue for the surrogate applies to all five soldiers."

Current video game technology lacks an easy-to-use method to issue such simultaneous commands to all members of a group.

The method also could be used to make maps interactive.

"In maps, usually you have a legend that says this color means forest and this symbol means railroad tracks and so on," Elmqvist said. "You can see these symbols in the map, but you can't interact with them. In the new approach, you have a surrogate of the map, and in this surrogate you can interact with these legends. For example, you could search for interstate highways, bridges, public parks."

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.

http://www.sciencedaily.com/releases/2011/05/110510121359.htm

Violence Doesn't Add to Children's Enjoyment of TV Shows, Movies

ScienceDaily (May 24, 2011) — Despite growing concern about the effects of media violence on children, violent television shows and movies continue to be produced and marketed to them. An Indiana University research study concludes that violence doesn't add anything to their enjoyment of such programs and their characters.

In a research study published in the journal *Media Psychology*, Andrew J. Weaver, an assistant professor of telecommunications in IU's College of Arts and Sciences, and colleagues tested a common view presented by media producers that children like to watch violent programming.

"Violence isn't the attractive component in these cartoons, which producers seem to think it is. It's more other things that are often associated with the violence. It's possible to have those other components, such as action specifically, in non-violent ways," Weaver said in an interview. "I think we should be concerned about violent content in cartoons in terms of the potential effect. This is one way that we can get around that from a producer's point of view.

"You don't have to cram violence into these cartoons to get kids to like them. They'll like them without the violence, just as much if not more," he said.

Violent cartoons have been a staple of Saturday morning programming for decades and now are readily available on cable television channels specializing in children's shows and cartoons. Many classic cartoons, such as those in the "Looney Tunes" series, have featured slapstick violence. But in recent years, action programs such as "Pokemon" and "Mighty Morphin Power Rangers" have drawn much attention both because of their violent content and their popularity with young people.

Some content analyses have found that as many as 70 percent of children's television shows have violent content.

"For many producers and media critics, the question is not if children love violence, but rather why children love violence," Weaver and his co-authors wrote in the paper. "Our goal in this study was to examine children's liking of violent content while independently manipulating the amount of action, which is often confounded with violence in the existing research."

Co-authors include Jakob Jensen of Purdue University, Nicole Martins of IU, Ryan Hurley of North Carolina State University and Barbara Wilson of the University of Illinois.

The researchers used a sample group of 128 school children, ranging in age from five to 11 and from kindergarten to the fourth grade. There were a nearly equal number of boys and girls.

Research assistants showed each child one of four versions of a five-minute animated short created for the study and then led them through a questionnaire. The short was designed to resemble familiar slapstick cartoons. Four different versions of the cartoon were used. Six violent scenes were added to one version, which was carried out by both characters and in response to earlier aggression. Nine action scenes were added to another version. Two other versions had lower amounts of action or violence.

What they found was violent content had an indirect negative effect on whether boys enjoyed a program, due to how they identified with the characters.

"That was a little surprising," said Weaver, the father of two young sons. "There is a lot of talk about boys being more violent and more aggressive, for whatever reason, social or biological, and yet we found that they

identified with the characters more when they were non-violent . . . They liked the characters more and they enjoyed the overall cartoon more.

"This is good news. If producers are willing to work on making cartoons that aren't violent so much as action packed, they can still capture their target audience better . . . and without the harmful consequences."

On the other hand, among girls violence did not decrease wishful identification of the characters. Weaver believes this may be because such slapstick cartoons are geared more toward boys than girls. Also, girls perceived the characters as boys, even though they were created without sexual attributes.

"They're not going to identify with what they perceive to be male characters, whether they are violent or not," he said. "They didn't prefer the more violent programming. They were just using other cues besides the character's violent or non-violent behavior to determine how much they enjoyed the show."

Weaver would like to apply his research to characters in more female-oriented programs, like "The Powerpuff Girls." He also recognizes that violence is seen by producers as an easy means to introduce action and conflict into a story.

"Alternatives could be things related to speed -- characters going fast, moving quickly. It was one way that we manipulated action in this study," he said. "If you can increase action without increasing violence, which clearly is possible as we did it in this study, then you can increase the enjoyment without potential harmful effects that violence can bring.

The cartoon the researchers used, "Picture Perfect Thief," featured a villain called Eggle, who attempted to steal a painting created by a hero called Orangehead. Eggle ultimately fails and the hero's painting wins first place in an art show. It was created by a friend using Macromedia Flash.

The violent version of the cartoon can be seen at http://www.youtube.com/watch?v=AU1-yL84bl4 and the less violent version is available at http://www.youtube.com/watch?v=ZiN26SiEd9c&feature=related.

Story Source:

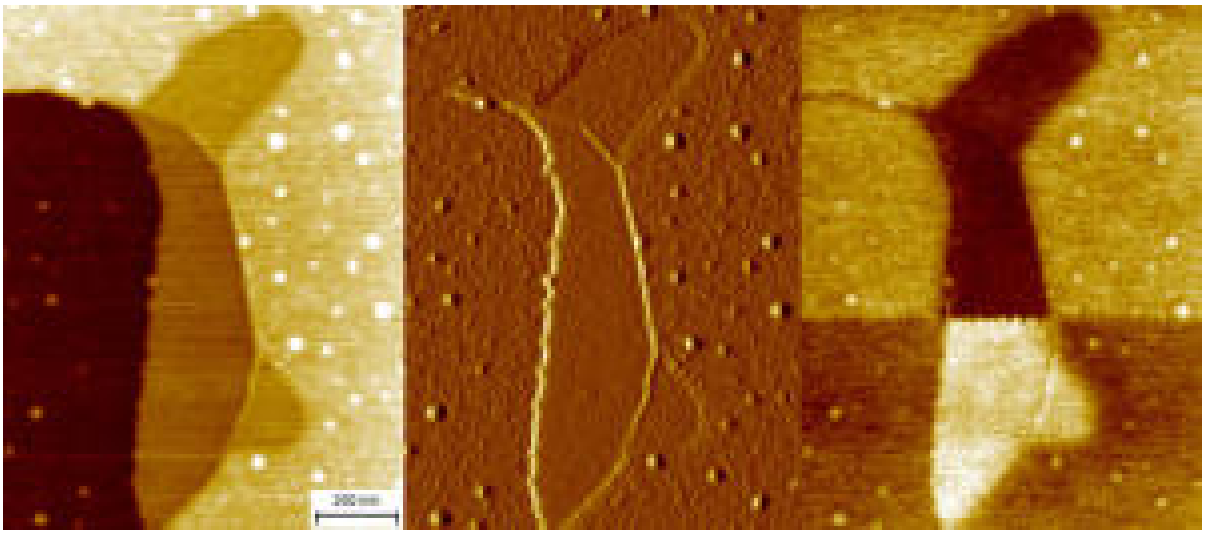
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Indiana University**.

Journal Reference:

1. Andrew Weaver, Jakob Jensen, Nicole Martins, Ryan Hurley, Barbara Wilson. **Liking Violence and Action: An Examination of Gender Differences in Children's Processing of Animated Content**. *Media Psychology*, 2011; 14 (1): 49 DOI: 10.1080/15213269.2010.547829

http://www.sciencedaily.com/releases/2011/05/110524070318.htm

Seeing an Atomic Thickness



The left hand image is the topography; the middle the topography error image; and right the electrostatic force microscopy image where the tip bias has been switched half way through the image. (Credit: Image courtesy of National Physical Laboratory)

ScienceDaily (May 24, 2011) — Scientists from the National Physical Laboratory (NPL), in collaboration with Linköping University, Sweden, have shown that regions of graphene of different thickness can be easily identified in ambient conditions using Electrostatic Force Microscopy (EFM).

The exciting properties of graphene are usually only applicable to the material that consists of one or two layers of the graphene sheets. Whilst synthesis of any number of layers is possible, the thicker layers have properties closer to the more common bulk graphite.

For device applications one- and two-layer graphene needs to be precisely identified apart from the substrate and regions of thicker graphene.

Exfoliated graphene sheets up to ~100 μm in size can be routinely identified by optical microscopy. However, the situation is much more complicated in the case of the epitaxial graphene grown on silicon carbide wafers with a diameter up to 5 inches where the straightforward identification of the graphene thickness is difficult using standard techniques.

This research shows that EFM, which is one of the most widely accessible and simplest implementations of scanning probe microscopy, can clearly identify different graphene thicknesses.

The technique can also be used in ambient environments applicable to industrial requirements.

Story Source:

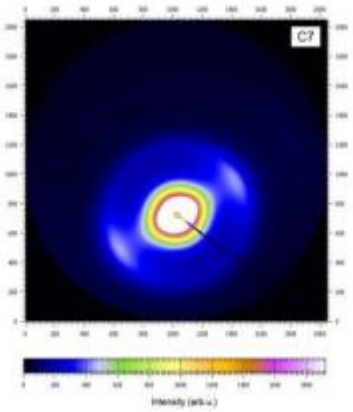
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Physical Laboratory**.

Journal Reference:

1. Tim Burnett, Rositza Yakimova, Olga Kazakova. **Mapping of Local Electrical Properties in Epitaxial Graphene Using Electrostatic Force Microscopy**. *Nano Letters*, 2011; 110428133938092 DOI: 10.1021/nl200581g

http://www.sciencedaily.com/releases/2011/05/110524094507.htm

New Beamline Allows Researchers to Study Variety of Materials With a Resolution of a Few Nanometers



The very first SAXS data measured av beamline 911-4 at MAX-lab, Lund. In the bottom left corner the result of the azimuthal integration of the measured data is plotted, intensity, I(q), vs. q. The measurement was made on Lupolen. Measuring time 60 s. (Credit: Image courtesy of Lund University)

ScienceDaily (May 24, 2011) — Using the new beamline, 911-4, at MAX-lab in Lund, Sweden, researchers can study a wide range of different types of material with a resolution of a few nanometres. This could be useful for both basic research and industry in general. The facility is the result of a Danish-Swedish collaboration. Now it is opening for research.

The new facility is a SAXS beamline, which means that it is used to examine the components of materials and their morphology with the help of an X-ray scattering method. This provides a rough picture of the structure of the sample and makes it possible to see the general shape and size of the particles or how close they are to one another.

The SAXS method can be used for any kind of sample (solids, liquids or gases). This makes it attractive for various different fields and classes of material -- SAXS is successfully used in the study of soft matter, mainly synthetic and natural polymers and biomacromolecules in solution, and is also relevant in the analysis of metals, alloys, glasses and porous materials in general. Basic and applied science fields can benefit from the use of the new facility.

SAXS beamlines are present in several synchrotron radiation facilities, and at MAX-lab the method has previously been used with great success on the I711 beamline. After five years of preparation, the new beamline is now open to users. The first experiments were done in February and the first measurements with external users were made in April.

One feature which makes MAX-lab's new SAXS beamline special is that it is unusually easy to use. The X-rays are also five-six times stronger than at the previous facility. The SAXS method is a very flexible technique that has become increasingly popular as new user groups have realised its potential. This was one of the reasons for the decision to build the new beamline.

The investment in the SAXS beamline 911-4 at the MAX II ring is a result of ongoing Danish-Swedish collaboration. Thanks to funding from sources including DANSCATT and expertise and staff from the University of Copenhagen and MAX-lab, the project has become a reality.

Facts:

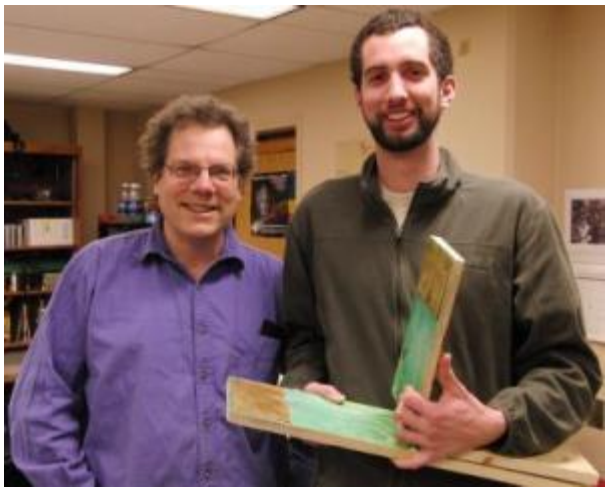
- Research is conducted at synchrotron radiation facilities all over the world. In Sweden there is one such laboratory: the national laboratory MAX-lab in Lund.
- SAXS stands for Small-Angle X-ray Scattering.
- Construction of a new synchrotron radiation facility in Sweden -- MAX IV -- has begun.
- There are also plans for a SAXS beamline at MAX IV.
- Research is conducted at the beamlines' experiment stations. Depending on how the beamline and the experiment station are constructed, different types of experiments can be carried out.

Story Source:

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

http://www.sciencedaily.com/releases/2011/05/110524081146.htm

New Way to Analyze a Bloody Crime Scene: Chicken Wing Sauce and Trigonometry Brought to Bear on CSI Enigma



WSU physicist Fred Gittes, left, and doctoral candidate Chris Varney used a "clapper" to spray simulated blood and develop a crime-scene investigation method of pinpointing the height a liquid comes from. (Credit: Washington State University photo)

ScienceDaily (May 24, 2011) — Don't get him wrong: Fred Gittes is, in his words, "extremely squeamish."

But then a scientist with forensics training told him that crime scene investigators could use a better way to analyze blood spatters. The physicist in Gittes rose to the challenge.

"It seems as though what was being done was very crude from a physics point of view and that intrigued me," he says.

Along with Chris Varney, a doctoral candidate in physics, Gittes has worked out a system that can often determine exactly where blood spatters originate, a critical piece of evidence in not only solving a crime but securing a conviction. A paper on their research, demurely titled "Locating the Source of Projectile Fluid Droplets," has now been accepted for publication in the *American Journal of Physics* and posted online.

Until now, investigators have been able to determine the direction a drop of blood has come from, with a stain's elliptical shape practically pointing to it. They've even been able to nail down a source along a vertical line. But the tougher part is figuring out how high up the source was.

"I talked informally with a public defender and he said that it's crucial to know the height because so often it's a self-defense issue," Gittes says. "A defendant may claim that a victim was standing rather than sitting. That's a big deal, apparently."

Gittes and Varney started tackling the problem with a clapper -- two boards on a hinge that could be clapped over a liquid, producing a spatter from a known and measurable height and angle. To get a liquid with blood-like impact shapes, they tinkered with corn syrup, food coloring and a variety of sauces before settling on a blend of Ashanti chicken wing sauce and Ivory dish soap.

Most of the math they used is at about the level of first-semester college physics. We'll spare you most of it, except to say they worked back from measurements of known spatters and sources and found that well known equations of projectile motion could be used to develop a formula giving them the height of a liquid's origin.

They also realized that, plotted on a graph with x and y axes, data points on specific drops form a neat line when the formula is working correctly. If drops are launched from too wide a range of angles, the method won't work and the data points won't line up, preventing investigators from making a false conclusion.

Gittes says he is chiefly interested in the new approach as a teaching tool, and a WSU geologist has expressed an interest in using similar methods to study lava fountains and volcanic debris. Gittes says he is content to leave any forensic application to crime scene investigators. Besides, he is way too squeamish.

Story Source:

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

Journal Reference:

1. Christopher R. Varney, Fred Gittes. **Locating the source of projectile fluid droplets**. *American Journal of Physics*, 2011; (accepted) [link]

http://www.sciencedaily.com/releases/2011/05/110524070313.htm

Breast Cancer Linked to Obesity Gene, New Research Suggests

ScienceDaily (May 23, 2011) — New research aimed to better identify the genetic factors that lead to breast cancer has uncovered a link between the fat mass and obesity associated gene (FTO) and a higher incidence of breast cancer. According to the study conducted at Northwestern Memorial Hospital, people who possess a variant of the FTO gene have up to a 30 percent greater chance of developing breast cancer. Research to identify why the link exists is ongoing, but experts say the finding takes us one step closer to personalized medicine based on genetic risk which would allow for better monitoring and prevention of illness, as well as targeted treatment.

"This is a fascinating early finding, which fits with the known connections between obesity and breast cancer," said Virginia Kaklamani, MD, oncologist at Northwestern Memorial, co-director of the Cancer Genetics Program at the Robert H. Lurie Comprehensive Cancer Center of Northwestern University and lead author of the study.

Each individual carries the FTO gene, but only 18 percent have this variant of the gene. Kaklamani, who specializes in cancer genetics, says testing for the FTO variant is not available currently, but it may be available in the future, similar to how genetic testing for the BRCA gene mutation exists today.

"Ten years ago we didn't know about the BRCA gene mutation which has been linked to breast and ovarian cancer. Today, we offer genetic testing and a specialized clinic for those at risk in order to minimize their risk and detect any indication of cancer early," said Kaklamani, who is also an associate professor of medicine at Northwestern University Feinberg School of Medicine. "This knowledge helps us better identify who is at an increased risk so one day, we can counter that risk through preventative measures and advanced screening."

The research, published in *BMC Medical Genetics* is part of an ongoing group of studies to further knowledge of genetic risk factors for breast cancer.

Story Source:

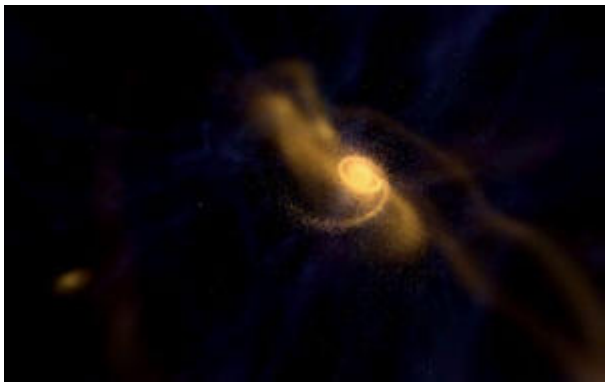
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Northwestern Memorial Hospital**.

Journal Reference:

1. Virginia Kaklamani, Nengjun Yi, Maureen Sadim, Kalliopi Siziopikou, Kui Zhang, Yianfei Xu, Sarah Tofilon, Surbhi Agarwal, Boris Pasche, Christos Mantzoros. **The role of the fat mass and obesity associated gene (FTO) in breast cancer risk**. *BMC Medical Genetics*, 2011; 12 (1): 52 DOI: 10.1186/1471-2350-12-52

http://www.sciencedaily.com/releases/2011/05/110523124402.htm

Just Four Percent of Galaxies Have Neighbors Like the Milky Way



This image, taken from a visualization created by the Advanced Visualization Laboratory at the National Center for Supercomputing Applications (NCSA), shows the formation of the Milky Way galaxy at 16 million to 13.7 billion years old. Brian O'Shea of Michigan State University (formerly of Los Alamos National Laboratory) and Michael Norman of the University of California at San Diego collaborated on this research. (Credit: National Center for Supercomputing Applications)

ScienceDaily (May 23, 2011) — How unique is the Milky Way?

To find out, a group of researchers led by Stanford University astrophysicist Risa Wechsler compared the Milky Way to similar galaxies and found that just four percent are like the galaxy Earth calls home.

"We are interested in how the Milky Way fits into the broader context of the universe," said Wechsler. "This research helps us understand whether our galaxy is typical or not, and may provide clues to its formation history."

The research team compared the Milky Way to similar galaxies in terms of luminosity--a measure of how much light is emitted--and distance to other bright galaxies. They found galaxies that have two satellites that are as bright and close by as the Milky Way's two closest satellites, the Large and Small Magellanic Clouds, are rare.

Published in the May 20 issue of the *Astrophysical Journal*, the findings are based on analyses of data collected from the Sloan Digital Sky Survey (SDSS). The work is the first of three papers that study the properties of the Milky Way's two most massive satellites.

Supported in part by the National Science Foundation (NSF), the SDSS is the most extensive survey of the optical sky performed to date.

In more than eight years of operations, SDSS has obtained images covering more than a quarter of the sky, and created 3-dimensional maps containing more than 930,000 galaxies and 120,000 quasars. For this analysis, Wechsler's group studied more than 20,000 galaxies with properties similar to the Milky Way and investigated the galaxies surrounding these Milky Way "twins," to create a "census" of galaxies similar to the Milky Way in the universe.

The work represents one of the most extensive studies of this kind ever performed.

Scientists can also compare the SDSS data to galaxies simulated by a computer model. Since they are currently unable to see all the way back to the Big Bang, this is one way researchers are trying to understand how the universe as we see it today began.

In order to learn more about possible conditions in the early universe, the group performed computer simulations to recreate the universe from specific sets of starting conditions. Then they compared their simulations to the SDSS data set. In this way, the group was able to test different theories of galaxy formation to determine whether or not each would result in a universe that matches what we see today. The results of their simulation matched the result found in the SDSS data set: just four percent of the simulated galaxies had two satellites like the Magellanic Clouds.

"This is an excellent example of data-enabled science," said Nigel Sharp, of NSF's Division of Astronomical Sciences. "Comparing the 'fake' and 'real' Universes is how we discriminate between successful and unsuccessful theories. This work interconnects three of the four legs of science: theory, observation and simulation, for a powerful scientific result."

Their results also lend support to a leading theory of galaxy formation called the Cold Dark Matter (CDM) theory. This theory provides what many consider to be the simplest explanation for the arrangement of galaxies throughout the universe following the Big Bang. It assumes that most of the matter in the Universe consists of material that cannot be observed by its electromagnetic radiation (dark) and whose constituent particles move slowly (cold). Dark matter, an invisible and exotic material of unknown composition, is believed to influence the distribution of galaxies in space and the overall expansion of the universe. The rareness of this aspect of the Milky Way may provide clues to its formation history.

"Because the presence of two galaxies like the Magellanic Clouds is unusual, we can use them to learn more about our own galaxy," said Wechsler. Using their simulation, the team identified a sample of simulated galaxies that had satellites matching the Milky Way's in terms of their locations and speeds.

"The combination of large surveys of the sky like the SDSS and large samples of simulated galaxies provides a new opportunity to learn about the place of our galaxy in the Universe," said Wechsler. "Future surveys will allow us to extend this study to even dimmer satellite galaxies, to build a full picture of the formation of our galaxy."

The theoretical and numerical work that produced the simulations used as a comparison for the SDSS data were supported by an award funded under the American Recovery and Reinvestment Act of 2009.

Story Source:

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

Journal Reference:

1. Lulu Liu, Brian F. Gerke, Risa H. Wechsler, Peter S. Behroozi, Michael T. Busha. **How Common Are the Magellanic Clouds?** *The Astrophysical Journal*, 2011; 733 (1): 62 DOI: 10.1088/0004-637X/733/1/62

http://www.sciencedaily.com/releases/2011/05/110523124206.htm

OCD: Compulsions Lead to Obsessions, Not the Other Way Around

New scientific evidence challenges a popular conception that behaviours such as repetitive hand-washing, characteristic of obsessive-compulsive disorder (OCD), are carried out in response to disturbing obsessive fears. (Credit: © Vladimir Voronin / Fotolia)

ScienceDaily (May 23, 2011) — New scientific evidence challenges a popular conception that behaviours such as repetitive hand-washing, characteristic of obsessive-compulsive disorder (OCD), are carried out in response to disturbing obsessive fears.

The study, conducted at the University of Cambridge in collaboration with the University of Amsterdam, found that in the case of OCD the behaviours themselves (the compulsions) might be the precursors to the disorder, and that obsessions may simply be the brain's way of justifying these behaviours. The research provides important insight into how the debilitating repetitive behaviour of OCD develops and could lead to more effective treatments and preventative measures for the disorder.

The research, funded by the Wellcome Trust and published in the *American Journal of Psychiatry*, tested 20 patients suffering from the disorder and 20 control subjects (without OCD) on a task which looked at the tendency to develop habit-like behaviour. Subjects were required to learn simple associations between stimuli, behaviours and outcomes in order to win points on a task.

The team, led by Claire Gillan and Trevor Robbins at the University of Cambridge MRC/Wellcome Trust Behavioural and Clinical Neuroscience Institute and Sanne de Wit at the University of Amsterdam, found that patients suffering from the disorder had a tendency to continue to respond regardless of whether or not their behaviour produced a desirable outcome. In other words, this behaviour was habitual. The discovery that compulsive behaviour -- the irresistible urge to perform a task -- can be observed in the laboratory, in the absence of any related obsessions, suggests that compulsions may be the critical feature of OCD.

Indeed, one of the most effective treatments for OCD is cognitive behavioural therapy (CBT), which typically involves a method known as "exposure and response prevention." This technique challenges patients to discontinue compulsive responding, and learn that the feared consequence does not occur, whether or not the behaviour is performed. The effectiveness of this treatment is compatible with the idea that compulsions, and not obsessions, are critical in OCD. Once the compulsion is stopped, the obsession tends to fade away.

"It has long been established that humans have a tendency to 'fill in the gaps' when it comes to behaviour that cannot otherwise be logically explained," said Claire Gillan, a PhD student at the University of Cambridge. "In the case of OCD, the overwhelming urge to senselessly repeat a behaviour might be enough to instil a very real obsessive fear in order to explain it."

Story Source:

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

Journal Reference:

1. C. M. Gillan, M. Papmeyer, S. Morein-Zamir, B. J. Sahakian, N. A. Fineberg, T. W. Robbins, S. de Wit. **Disruption in the Balance Between Goal-Directed Behavior and Habit Learning in Obsessive-Compulsive Disorder**. *American Journal of Psychiatry*, 2011; DOI: 10.1176/appi.ajp.2011.10071062

http://www.sciencedaily.com/releases/2011/05/110523101915.htm

Shave Biopsy Is a Safe and Acceptable Method for Initial Evaluation of Melanoma, Study Suggests

ScienceDaily (May 23, 2011) — A shave biopsy is a reasonably safe and accurate method for the initial diagnosis of melanoma, according to a study published in the April issue of the *Journal of the American College of Surgeons*. In the past, some physicians have criticized shave biopsies for not providing accurate T (tumor) stage information, thereby complicating treatment planning.

"We conducted this study to determine the impact of shave biopsies on the initial staging of melanoma and their impact on the final treatment planning for patients," explained Jonathan S. Zager, MD, FACS, associate professor at the Moffitt Cancer Center, Tampa, FL, and lead author of the study. "Shave biopsies are commonly used by dermatologists, primary care physicians, and surgeons as a less invasive and more efficient means of biopsying suspicious lesions for diagnosis."

In the largest study to date, researchers at Moffitt Cancer Center and the University of Florida Shands Cancer Center, Gainesville, retrospectively analyzed 600 consecutive patients who underwent a shave biopsy for suspicious skin lesions between 2006 and 2009. They found presumptive pre-shave diagnosis of melanoma was suspected in only 25 percent of these patients. After definitive surgical wide excision was performed, 133 (22 percent) had residual melanoma in the surgical excision specimen. However, the detection of residual melanoma in these patients only resulted in subsequent upstaging in T-stage in a small group of 18 (3 percent) patients, showing that T-stage and depth data obtained through shave biopsy were accurate in 97 percent of all patients.

"The diagnosis of melanoma can be extremely challenging, even for the most experienced health care professional," Dr. Zager said. "Although traditional excisional biopsy remains the gold standard for the diagnosis of suspicious skin lesions, where a rim of normal appearing skin can be excised with the specimen (especially when melanoma is suspected), our results show shave biopsies may be used as a first-line evaluation for skin lesions with minimal impact on T-staging and definitive treatment options."

While there are advantages and disadvantages to consider when comparing excisional, punch, and shave biopsies of skin lesions, the disadvantages of shave biopsies remain largely cosmetic. Because shave biopsies don't require sutures for closure, a depressed, hypopigmented or hyperpigmented scar may sometimes occur. Punch biopsies present physicians with limitations with regard to the size of the biopsy tools available to accommodate an accurate biopsy, as best practices generally recommend excision of some normal appearing skin at the edges of the skin lesion in question.

According to the American Cancer Society, skin cancer accounts for almost half of all cancers in the United States. Melanoma, the most severe form of skin cancer, affected about 68,130 people in 2010 alone.

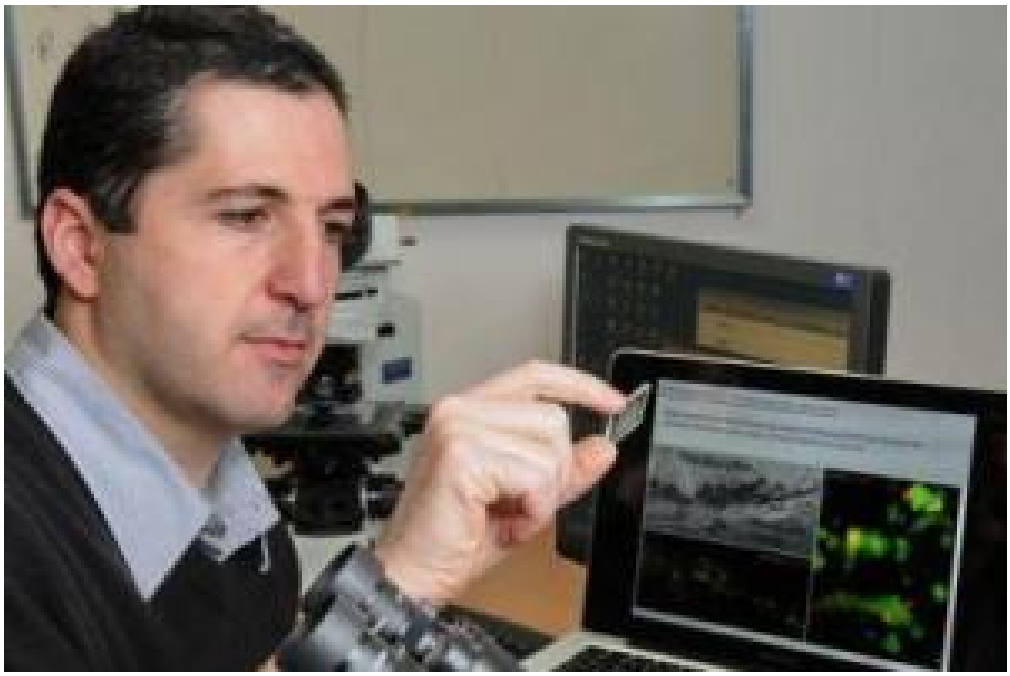
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Weber Shandwick Worldwide**.

Journal Reference:

1. Jonathan S. Zager, Steven N. Hochwald, Suroosh S. Marzban, Rony Francois, Kimberly M. Law, Ashley H. Davis, Jane L. Messina, Vladimir Vincek, Christina Mitchell, Ann Church, Edward M. Copeland, Vernon K. Sondak, Stephen R. Grobmyer. **Shave Biopsy Is a Safe and Accurate Method for the Initial Evaluation of Melanoma**. *Journal of the American College of Surgeons*, 2011; 212 (4): 454 DOI: 10.1016/j.jamcollsurg.2010.12.021

http://www.sciencedaily.com/releases/2011/05/110523124400.htm

Pre-Meal Dietary Supplement Can Help Overcome Fat and Sugar Problems, Study Suggests



This is Yaakov Nahmias of the Hebrew University of Jerusalem. (Credit: Hebrew University of Jerusalem photo)

ScienceDaily (May 23, 2011) — A little bitter with a little sweet, in the form of a nano-complex dietary supplement taken before meals, can result in a substantial reduction of fat and sugar absorption in the body, Hebrew University of Jerusalem and Harvard University researchers have found.

The researchers previously showed that naringenin, the molecule responsible for the bitter taste in grapefruits, could potentially be used in the treatment of diabetes, arteriosclerosis and hyper-metabolism.

However, the absorption of naringenin in its natural form is very low. To overcome this obstacle, the Hebrew University-Harvard research team, led by Dr. Yaakov Nahmias of the Benin School of Engineering and Computer Science at the Hebrew University and his graduate student, Maria Shulman, has now created, through further research, a nano-complex of naringenin within a ring of sugar called cyclodextrin. This complex increased the absorption of naringenin by 11 times.

What the researchers found is that a single dose of this complex, taken just before a high fat and high sugar meal given to rats, was able to reduce the generation of VLDL (bad cholesterol) by 42%, and increase insulin sensitivity by 64%.

This is the first demonstration that a dietary supplement can change the way our body can react beneficially to a meal. The discovery is detailed in an article that has been published in the scientific journal, *PLoS One*.

"The complex is special in that it is taken just before a meal, as a preventative measure. In comparison, existing medications are given only after the chronic development of abnormal lipid levels in the blood," said Dr. Nahmias.

The scientists say that considering the sugary taste of cyclodextrin, naringenin, the cause of the bitter taste in grapefruit, is "no longer such a bitter pill to swallow."

Patents for the development have been applied for by Harvard University and Yissum, the technology transfer company of the Hebrew University, and clinical tests are now under way in the United States.

Story Source:

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

Journal Reference:

1. Maria Shulman, Merav Cohen, Alejandro Soto-Gutierrez, Hiroshi Yagi, Hongyun Wang, Jonathan Goldwasser, Carolyn W. Lee-Parsons, Ofra Benny-Ratsaby, Martin L. Yarmush, Yaakov Nahmias. **Enhancement of Naringenin Bioavailability by Complexation with Hydroxypropoyl-β-Cyclodextrin**. *PLoS ONE*, 2011; 6 (4): e18033 DOI: 10.1371/journal.pone.0018033

http://www.sciencedaily.com/releases/2011/05/110523101919.htm

U.S. Honey Bee Losses at 30% for 2010-2011 Winter

ARS-AIA survey reports honey bees losses holding about steady. (Credit: Photo courtesy of Russ Ottens, University of Georgia, Bugwood.org.)

ScienceDaily (May 23, 2011) — Total losses from managed honey bee colonies nationwide were 30 percent from all causes for the 2010/2011 winter, according to the annual survey conducted by the U.S. Department of Agriculture (USDA) and the Apiary Inspectors of America (AIA).

This is roughly similar to total losses reported in similar surveys done in the four previous years: 34 percent for the 2009/2010 winter, 29 percent for 2008/2009; 36 percent for 2007/2008, and 32 percent for 2006/2007.

"The lack of increase in losses is marginally encouraging in the sense that the problem does not appear to be getting worse for honey bees and beekeepers," said Jeff Pettis, an entomologist with USDA's Agricultural Research Service (ARS) who helped conduct the study. "But continued losses of this size put tremendous pressure on the economic sustainability of commercial beekeeping." Pettis is the leader of the Bee Research Laboratory operated in Beltsville, Md., by ARS, the chief scientific research agency of USDA.

The survey, which covered the period from October 2010 to April 2011, was led by Pettis and by AIA past presidents Dennis vanEngelsdorp and Jerry Hayes.

Beekeepers reported that, on average, they felt losses of 13 percent would be economically acceptable. Sixty-one percent of responding beekeepers reported having losses greater than this.

Average colony loss for an individual beekeeper's operation was 38.4 percent. This compares to an average loss of 42.2 percent for individual beekeepers' operations in 2009/2010.

Average loss by operation represents the percentage of loss in each operation added together and divided by the number of beekeeping operations that responded to the survey. This number is affected more by small beekeeping operations, which may only have 10 or fewer colonies, so a loss of just five colonies in a 10-colony operation would represent a 50 percent loss. Total losses were calculated as all colonies reported lost in the survey divided by the total number of bee colonies reported in the survey. This number is affected more by larger operations, which might have 10,000 or more colonies, so a loss of five colonies in a 10,000-colony operation would equal only a 0.05 percent loss.

Among surveyed beekeepers who lost any colonies, 31 percent reported losing at least some of their colonies without finding dead bee bodies -- one of the symptoms that defines Colony Collapse Disorder (CCD). As this was an interview-based survey, it was not possible to differentiate between verifiable cases of CCD and colonies lost as the result of other causes that share the "absence of dead bees" as a symptom. The cause of CCD is still unknown.

The beekeepers who reported colony losses with no dead bee bodies present also reported higher average colony losses (61 percent), compared to beekeepers who lost colonies but did not report the absence of dead bees (34 percent in losses).

A total of 5,572 beekeepers, who manage more than 15 percent of the country's estimated 2.68 million colonies, responded to the survey.

A complete analysis of the survey data will be published later this year. The abstract can be found at http://www.extension.org/pages/58013/honey-bee-winter-loss-survey .

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **USDA/Agricultural Research Service**. The original article was written by Kim Kaplan.

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http://www.sciencedaily.com/releases/2011/05/110523124214.htm

Genetic Fine Print With Big Consequences: Multiple Stop Points in Genes Are More Important Than Thought

Top: Abdomen of the normal fruit fly (left) and without the termination signal (full stop) (middle and right). Bottom: A normal fly (left) and one of the few survivors that did not have the full stop in the polo gene (right). (Credit: Image courtesy of Instituto de Biologia Molecular e Celular)

ScienceDaily (May 23, 2011) — A fly without an abdomen is the devastating result of a small genetic change discovered by a Portuguese team. When you remove the stop-signal from a fruit fly gene, the flies suffer developmental abnormalities and die. An article, published in *The EMBO Journal* by IBMC investigators shows that it matters which of the two polo gene stop-signals cells use. And that losing the second one leads to severe problems with normal development and eventually, death.

For genetic material to be decoded successfully, the genome carries signals or marks, a type of punctuation. These show the machinery of the cell where genes start and stop when they are copying the nuclear genetic material into messenger RNAs that carry information to the protein factories to make the constituents of the cell. During the de-codification of the genes there is a small mark -- named a polyadenylation signal -- that indicates to the cell "the message ends here" or "the full stop of genes," explains Alexandra Moreira3, who coordinated the research team. The work also involved two other groups: one at the IBMC, led by Claudio Sunkel and the other at the University of Oxford, led by Nicholas Proudfoot, who discovered polyadenylation signals more than 30 years ago.

However, the majority of genes have more than one stop-signal. Many researchers have tried to understand why this signal is often duplicated and how multiple stop-signals are read. At first it was thought that multiple signals ensure a definite stop and avoid the situation where a cell misses the first and continues to make a copy indefinitely with potentially serious consequences. Recent cellular studies have allowed us to understand that there is a correlation between the use of a particular full stop and cancer. However, so far these studies had only looked at these multiple polyadenylation signals in cells, not permitting the analysis of their effect on the whole organism.

What the Portuguese team did was to look for the first time at what effect alternative full stops in a gene could have at a whole organism level using the fruit fly as a model system. They used a gene, polo, with two possible polyadenylation signals, a gene which has a key role in cell division, is strongly associated with various forms of cancer and which has been considered as a target for gene therapy. The polo gene is the founder of a protein kinase family that was firstly identified by members of the research team.

The results were surprising and more dramatic than they could have expected: "when we make the fly using only the first stop-signal the effect is lethal" confirmed Alexandra Moreira. It seems that the presence of both full stop marks "allows more effective regulation of the levels of the resulting proteins." The authors state that the research findings are still more important at another level, they provide a solid basis to explain the dynamics of producing different RNAs within an organism.

The major novel finding of this work is "to show for the first time in a living organism the function of these genetic signatures and the serious physiological consequences that mutations in these signals can have. Our work opens new possibilities of targets for the development of gene therapy in the future," explain the authors.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Instituto de Biologia Molecular e Celular**, via AlphaGalileo.

Journal Reference:

1. Pedro A B Pinto, Telmo Henriques, Marta O Freitas, Torcato Martins, Rita G Domingues, Paulina S Wyrzykowska, Paula A Coelho, Alexandre M Carmo, Claudio E Sunkel, Nicholas J Proudfoot, Alexandra Moreira. **RNA polymerase II kinetics in polo polyadenylation signal selection**. *The EMBO Journal*, 2011; DOI: 10.1038/emboj.2011.156

http://www.sciencedaily.com/releases/2011/05/110520122128.htm

Scientists Explore Hidden World of Ancient Maritime Maya

Explorers sit atop the ancient Maya pyramid at Vista Alegre. The pyramid stands 35-feet tall and may have been used by Maya lookouts to monitor approaching and departing canoes. (Credit: Image courtesy of Proyecto Costa Escondida Maritime Maya 2011 Expedition, NOAA-OER)

ScienceDaily (May 23, 2011) — NOAA-sponsored explorers are searching a wild, largely unexplored and forgotten coastline for evidence and artifacts of one of the greatest seafaring traditions of the ancient New World, where Maya traders once paddled massive dugout canoes filled with trade goods from across Mexico and Central America. One exploration goal is to discover the remains of a Maya trading canoe, described in A.D. 1502 by Christopher Columbus' son Ferdinand, as holding 25 paddlers plus cargo and passengers.

Through the end of May, the team is exploring the remote jungle, mangrove forests and lagoons at the ancient port site of Vista Alegre ("happy view" in Spanish) where the Caribbean meets the Gulf of Mexico at the northeastern tip of the Yucatan Peninsula. Scientists believe the port was part of an important trading network and was used at various times between about 800 B.C. and A.D. 1521, the date scholars use to designate the start of Spanish rule.

"The maritime Maya have been described much like ancient seagoing Phoenicians. They traded extensively in a wide variety of goods, such as bulk cotton and salt, and likely incense from tree sap called copal, jade, obsidian, cacao, Quetzal and other tropical bird feathers, and even slaves," said Dominique Rissolo, Ph.D., expedition co-chief scientist and director of the Waitt Institute in La Jolla, Calif. "Maya trade was far-ranging between the Veracruz coast of modern Mexico and the Gulf of Honduras, with each port a link in a chain connecting people and ideas. Yet there is still much to learn about the extensive history and importance of the maritime Maya and how they adapted to life by the sea."

"Maritime economies were strengthened and far-ranging trade routes were established between A.D. 850 and 1100," said Jeffrey Glover, Ph.D., expedition co-chief scientist with Georgia State University's Department of Anthropology in Atlanta. "It was during this time when the Maya at Chichen Itza relied increasingly on maritime commerce to maintain and extend control over much of the Yucatan peninsula. The period most associated with Maya seafaring followed, between A.D. 1100 and 1521."

Recent archaeological work at Vista Alegre included completion of an architectural map of the site, test excavations to obtain cultural materials, and a 13-mile reconnaissance of coastal environments that revealed a number of small ancient and historical sites and cultural features.

During expeditions at the port site in 2005 and 2008, explorers mapped 29 structures including platforms, mounds, raised causeways, and a concrete-filled 35-foot tall, steep-sided pyramid that dominates the central plaza and appears to have been heavily damaged by hurricanes. Explorers believe the summit of the pyramid

was also used by lookouts to monitor approaching and departing canoes. In addition to the features on the island, a narrow walkway connects the port to a collapsed and looted temple 0.8 miles away on the mainland.

The expedition team also includes co-chief scientists Patricia Beddows, Ph.D., of Northwestern University's Department of Earth and Planetary Sciences in Evanston, Illinois; Beverly Goodman, Ph.D., of the Leon Charnet School of Marines Sciences at the University of Haifa, Israel; and Derek Smith, of the University of Washington Department of Biology. Emily McDonald of NOAA's Office of Ocean Exploration and Research is on the team to coordinate Web coverage.

Two scientists from Mexico and a small number of U.S. students will join parts of the expedition, which will also provide post-expedition technical reports to the Mexican National Institute of Anthropology and History. A goal of the exploration is to enable Mexico to better protect and preserve its coastal and submerged cultural resources.

The explorers are contending with many of the same challenges that faced ancient Maya seafarers, including shelter -- as some team members will be in tents and slung hammocks -- the remoteness of the area that is accessible only by boat, the scarcity of fresh water, the possibility of tropical storms, and the danger and nuisance of a variety of local inhabitants, including mosquitoes, snakes, spiders and crocodiles.

"The Maya largely had to live off the land in this remote area where they found and used resources to survive. Like them, we have to search for scarce fresh water, but our challenges are more about making the research work in less than optimal conditions. It will involve some good MacGyvering," said Glover, referring to the television actor who used ingenuity and materials at hand to invent his way out of a fix.

The expedition is part of Proyecto Costa Escondida (Hidden Coast Project), a long-term interdisciplinary research effort co-directed by Glover and Rissolo and focused on the dynamic relationship between the Maya and their coastal landscape.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Oceanic and Atmospheric Administration**.

http://www.sciencedaily.com/releases/2011/05/110523080535.htm

Platform Developed to Monitor Hematopoietic Stem Cells

ScienceDaily (May 23, 2011) — A Canadian research team has developed an automated microfluidic cell culture platform to monitor the growth, survival and responses of hundreds of hematopoietic stem cells (HSCs) at the single cell level.

This new tool allows scientists to study multiple temporally varying culture conditions simultaneously and to gain new insights on the growth factor requirements for HSC survival.

"The ability to perform massively parallel cultures of single non-adherent mammalian cells will provide new avenues to explore complex biological questions," says Véronique Lecault, lead author of the study and a PhD candidate in the UBC Dept. of Chemical and Biological Engineering.

"Our results will find use in broader applications such as drug development, clone selection and culture optimization," says Lecault.

The findings appear in the May 22 issue of the online journal *Nature Methods.* The study is a collaborative project between the laboratories of Asst. Prof. Carl Hansen, UBC Physics and Astronomy, Centre for High-Throughput Biology, Prof. James Piret, UBC Chemical and Biological Engineering, Michael Smith Laboratories, Prof. Connie Eaves, Terry Fox Laboratory, BC Cancer Agency, and Dr. Keith Humphries, Terry Fox Laboratory, BC Cancer Agency.

Lecault explains that HSCs are found mainly in adult bone marrow and have the astounding ability to sustain the continuous production of specialized blood cells.

These cells have major clinical implications, in particular for the treatment of cancer and blood-borne diseases, but the mechanisms regulating their division into stem cells (self-renewal) or more mature cells (differentiation) are not very well understood.

The heterogeneous nature of hematopoietic populations further complicates the study of these rare HSCs by hiding individual responses into average measurements. Single cell studies are therefore critical to elucidate these mechanisms but current techniques are labour intensive, require expensive reagents and provide limited flexibility to characterize cells or exchange culture conditions.

The team designed and fabricated microfluidic devices -- about the size of a matchbox -- containing 1,600 to 6,400 miniature culture chambers that can sustain robust cell growth, along with an automated time-lapse imaging system to track clones over multiple days as they expand from single cells.

"There are many challenges associated with the culture of suspension cells in nanolitre volumes including dehydration, nutrient limitations, and rapid variations if culture conditions are not well controlled," says Lecault.

The team was able to solve these problems by integrating an osmotic bath to block evaporation combined with a unique geometry that allows for automated medium exchange, immunostaining on live clones and cell recovery.

Story Source:

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

Journal Reference:

1. Véronique Lecault, Michael VanInsberghe, Sanja Sekulovic, David J H F Knapp, Stefan Wohrer, William Bowden, Francis Viel, Thomas McLaughlin, Asefeh Jarandehei, Michelle M Miller, Didier Falconnet, Adam K White, David G Kent, Michael R Copley, Fariborz Taghipour, Connie J Eaves, R Keith Humphries, James M Piret, Carl L Hansen. **High-throughput analysis of single hematopoietic stem cell proliferation in microfluidic cell culture arrays**. *Nature Methods*, 2011; DOI: 10.1038/nmeth.1614

http://www.sciencedaily.com/releases/2011/05/110522141558.htm

Changes in Vegetation Determine How Animals Migrate

Caribou on the tundra. Researchers compared how Mongolian gazelle migrate to the movement of three other ungulate species: guanaco in the Patagonian Steppes in Argentina, caribou in the arctic tundra of Canada and Alaska and moose in temperate forests in Massachusetts. (Credit: © Lars Johansson / Fotolia)

ScienceDaily (May 23, 2011) — The predictability and scale of seasonal changes in a habitat help determine the distance migratory species move and whether the animals always travel together to the same place or independently to different locations, according to a paper published online in February in *Global Ecology and Biogeography* by the National Zoo's Smithsonian Conservation Biology Institute researchers and partners.

The study's findings have significant implications for land managers around the world working to conserve endangered species that migrate.

"We knew that Mongolian gazelle in the Eastern Steppes migrate long distances, but when we put radio collars on them, we were surprised to discover that they go off individually in different directions," said Thomas Mueller, a research associate at SCBI and lead author of the study.

"Previously researchers had not paid much attention to how individual animals that migrate long distances move relative to one another," Mueller added.

The researchers compared how Mongolian gazelle migrate to the movement of three other ungulate species: guanaco in the Patagonian Steppes in Argentina, caribou in the arctic tundra of Canada and Alaska and moose in temperate forests in Massachusetts. SCBI's primary role in collaboration with University of Maryland was to provide the remote tracking technology and statistical analysis, while other partners organized and executed the field work in each of the areas.

After determining how far each species migrated and whether individuals moved together or independently from each other in different directions, the scientists compared these results to 25 years of satellite data from the National Oceanic and Atmospheric Administration showing seasonal and annual changes in landscape dynamics. They found that the species that moved the largest distances (caribou and gazelle) live in areas where vegetation (their food source) varies over large scales, while those that moved shorter distances (guanaco and moose) live in areas where the vegetation varies at a much smaller scale.

They also found that Mongolian gazelles, which move independently in different directions compared to one another other, live in habitats with the least predictable landscape dynamics.

"What this indicates is that while it may be appropriate to put barriers around landscapes where endangered species stay in herds as they migrate, species that migrate long distances as individuals require conservation

strategies that facilitate long-distance movements across the entire landscape," said Scott Derrickson, deputy director of SCBI. "We now know some of the landscape factors that we can look at to determine the best way to manage habitat for endangered or threatened species."

SCBI will spearhead the next steps in the research: expanding the number of species and the number of study regions and refining the statistical methods quantifying how individuals move relative to one another. The researchers also want to understand how the animals know how to navigate the landscapes -- whether through memory or through other sensory mechanisms -- and if those mechanisms differ between the species that migrate as herds or as individuals.

The paper's authors from SCBI are Mueller, Peter Leimgruber and Justin Calabrese.

Story Source:

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

Journal Reference:

1. Thomas Mueller, Kirk A. Olson, Gunnar Dressler, Peter Leimgruber, Todd K. Fuller, Craig Nicolson, Andres J. Novaro, Maria J. Bolgeri, David Wattles, Stephen DeStefano, Justin M. Calabrese, William F. Fagan. **How landscape dynamics link individual- to population-level movement patterns: a multispecies comparison of ungulate relocation data**. *Global Ecology and Biogeography*, 2011; DOI: 10.1111/j.1466-8238.2010.00638.x

http://www.sciencedaily.com/releases/2011/05/110511142138.htm

New Green Technology for Hydrogen Production

Eindhoven University researcher Mohamed Halabi at his research set-up. (Credit: Bart van Overbeeke)

ScienceDaily (May 23, 2011) — Researcher Mohamed Halabi of Eindhoven University of Technology demonstrates a proof-of-concept for a new and clean technology to produce high purity hydrogen from natural gas. This allows hydrogen to be produced in an elegant technique at much lower temperatures, and without releasing carbon dioxide into the atmosphere.

Hydrogen is a valuable feedstock for the petrochemical industry and it may play a big role in the energy supply of the future, as a green, non-polluting, and efficient energy carrier. If it is burnt, only water is formed. However, the conventional technology for hydrogen production from natural gas ('steam reforming') is a highly energy intensive process, operated at high pressures (up to 25 bar) and high temperature (850 degrees C), with multistage subsequent separation and purification units. Moreover, huge amounts of CO_2 have to be handled in post-processing steps.

TU Eindhoven has now developed a new and improved technology called "sorption enhanced catalytic reforming of methane," using novel catalyst/sorbent materials. Halabi, working in collaboration with the Energy Research Centre of the Netherlands (ECN), has demonstrated the feasibility of producing hydrogen through such a process at much lower temperatures (400 to 500 degrees Celsius).

The process is performed in a packed bed reactor using a Rhodium-based catalyst and a Hydrotalcite-based sorbent as a new system of materials. Hydrogen is produced on the active catalyst and the cogenerated CO_2 is effectively adsorbed on the sorbent, hence preventing any CO_2 emissions to the atmosphere.

Halabi: "Direct production of high purity hydrogen and fuel conversion greater than 99.5% is experimentally achieved at low temperature range of (400 -- 500 ºC) and at a pressure of 4.5 bar with a low level of carbon

oxides impurities: less than 100 ppm." The enormous reduction of the reactor size, material loading, catalyst/sorbent ratio, and energy requirements are beneficial key factors for the success of the concept over the conventional technologies. Small size hydrogen generation plants for residential or industrial application operated at a relatively low pressure, of less than 4.5 bar, seem to be feasible.

Dr. Mohamed Halabi received his PhD on May 9, 2011, at TU Eindhoven based on his dissertation "Sorption Enhanced Catalytic Reforming of Methane for Pure Hydrogen Production -- Experimental and Modeling." He conducted his research at the laboratory of Chemical Reactor Engineering, under the supervision of Prof. Jaap Schouten.

Story Source:

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

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http://www.sciencedaily.com/releases/2011/05/110512103946.htm

Younger Doctors Prescribe More Drugs to Reduce Heart Risk but Offer Less Lifestyle Advice, Study Finds

ScienceDaily (May 23, 2011) — Patients with heart disease risks are more likely to be prescribed cardiovascular (CV) drugs if they see a younger doctor and recommended to change their lifestyle if they see an older doctor, according to research in the June issue of IJCP, the International Journal of Clinical Practice.

Researchers studied the attitudes and prescribing trends of 1,078 family doctors, cardiologists and diabetologists, together with clinical data on 9,904 of their outpatients. The study found that although younger doctors prescribed more drugs, this did not result in significantly better control of their patients' major CV risk factors. This suggests that other factors have an important role to play in the clinical management of CV risk, including lifestyle changes.

Italian researchers studied the attitudes and prescribing trends of 1,078 family doctors, cardiologists and diabetologists, together with clinical data on 9,904 of their outpatients, after inviting the doctors to take part in an educational training programme on managing CV risk.

"While physicians recognise the importance of patients' age as a major driver for CV risk, little evidence is available on the potential impact of the doctor's age on how they manage clinical risk" says cardiologist Professor Massimo Volpe from the Faculty of Medicine at Sapienza University, Rome.

"Although younger doctors prescribed more drugs, this did not result in significantly better control of their patients' major CV risk factors, suggesting that other factors have an important role to play in the clinical management of CV risk, including lifestyle changes."

The doctors, who were blind to the final purpose of the study, were selected by two-dozen regional referral centres, with 90% agreeing to take part.

All the doctors were asked to fill in questionnaires on themselves and their practice and reply anonymously on the administrative site of their regional referral centre. They were also asked to provide clinical details of the first 10 white patients over 50 they saw, for any reason, after they agreed to take part.

A fifth of the doctors (20%) were under 45 years of age, 61% were 46-55 and 19% were over 55. Female doctors accounted for 27% of the total sample and tended to be younger, ranging from 47% of those under 45 to just 8% of those over 55.

Family doctors accounted for 78% of the total sample, followed by cardiologists (13%) and diabetologists (9%). The youngest age group included the fewest GPs (53%) and most cardiologists (31%), with the highest percentage of GPs in the 46-55 age group (86%).

Just over half of the patients (54%) were male. The average age was 67 and the ages of the patients treated by the doctors in the various age groups was very similar. However, doctors over 55 tended to treat more male patients, obese patients and smokers.

Key findings of the study included:

- High blood pressure was the most common CV risk factor, affecting 75% of patients, followed by abnormal lipid (cholesterol and/or fat in the blood) in 59% of patients and diabetes mellitus in 37%. In each case, the percentage was highest in patients managed by doctors under 45.
- Blood pressure drugs were the most commonly prescribed, by 83% of doctors under 45, 78% of doctors aged 46-55 year-old and 80% of doctors over 55. However, not all patients with high blood

pressure were prescribed drugs, regardless of the age of their physician. This is consistent with research that shows that high blood pressure is widely undertreated and a key element in the global burden of CV disease in western countries.

- Younger doctors were also more likely to prescribe antidiabetic drugs, lipid-lowering agents and antiplatelet agents than their older colleagues.
- Older doctors were more likely to recommend lifestyle changes. Smoking cessation advice was highest in doctors over 55 and diet and exercise advice highest in doctors aged 46-55.
- Older doctors also tended to be more thorough and accurate when it came to recording clinical data on their patients. Previous analysis of the data provided showed a close relationship between high levels of accuracy and better CV outcomes.

"Our study demonstrated a significantly higher prevalence of major CV risk factors and associated clinical conditions among patients treated by younger, specialised doctors, rather than older doctors, who were more likely to be GPs" says Professor Volpe.

"Younger doctors were also more likely to prescribe medication and less likely to recommend lifestyle changes than their older colleagues. However this increased prescribing was not reflected in significantly better clinical management of CV risk factors.

"We believe these findings have important implications for the ongoing professional education of doctors treating patients with CV risk."

Story Source:

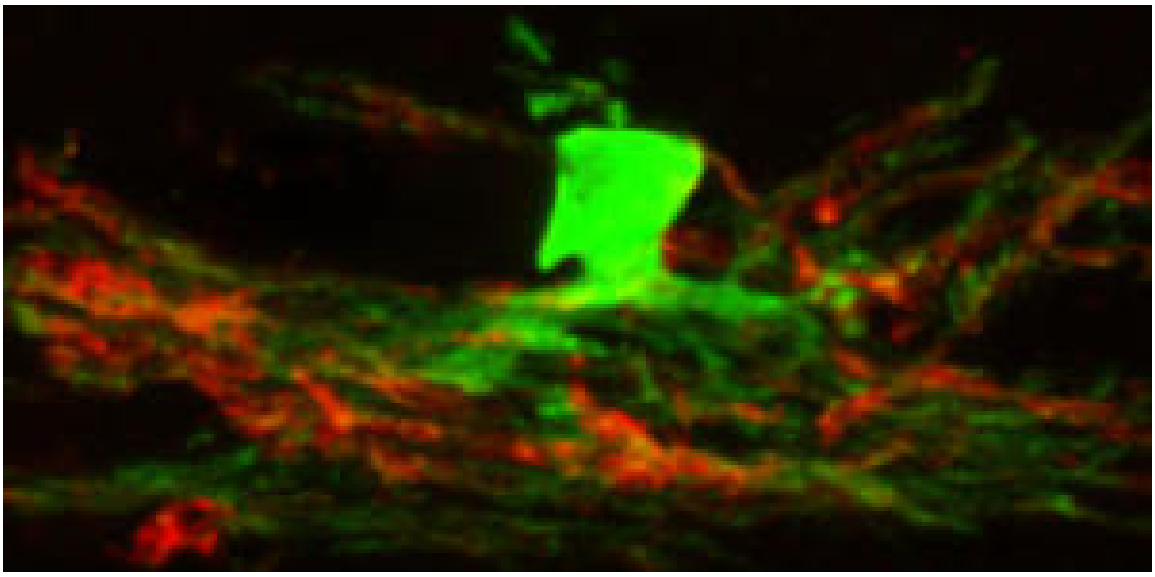
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Wiley-Blackwell**, via AlphaGalileo.

Journal Reference:

1. G. Tocci, A. Ferrucci, P. Guida, A. Avogaro, M. Comaschi, A. Corsini, C. Cortese, C. B. Giorda, E. Manzato, G. Medea, G. F. Mureddu, G. Riccardi, G. Titta, G. Ventriglia, G. B. Zito, M. Volpe. **Impact of physicians' age on the clinical management of global cardiovascular risk: analysis of the results of the Evaluation of Final Feasible Effect of Control Training and Ultra Sensitisation Educational Programme**. *International Journal of Clinical Practice*, 2011; 65 (6): 649 DOI: 10.1111/j.1742-1241.2011.02664.x

http://www.sciencedaily.com/releases/2011/05/110516080118.htm

A New Program for Neural Stem Cells



Transplantation of reprogrammed neural stem cells into the brains of genetically modified mice, which cannot form myelin. The stem cells develop oligodendrocytes (green), which form myelin (red). (Credit: Max Planck Institute for Brain Research)

ScienceDaily (May 23, 2011) — Neural stem cells can do a lot, but not everything. For example, brain and spinal cord cells are not usually generated by neural stem cells of the peripheral nervous system, and it is not possible to produce cells of the peripheral nervous system from the stem cells of the brain. However, researchers from the Max Planck Institute for Brain Research in Frankfurt and the Max Planck Institute of Immunobiology and Epigenetics in Freiburg have now succeeded in producing central nervous system cells from neural stem cells of the peripheral nervous system. They found that if peripheral stem cells are maintained under defined growth conditions, they generate oligodendrocytes, which form the myelin layer that surrounds the neurons found in the brain and spinal cord.

The mammalian nervous system consists of a central (brain, spinal cord) and peripheral nervous system (e.g. nerves and sensory ganglia). Although the two systems are very closely interlinked, they differ anatomically and consist of different cell types. The cell types of the peripheral nervous system originate from precursor cells in the embryo called the neural crest. To date, it was believed that these neural crest stem cells could generate the neurons and support cells, known as glial cells, of the peripheral nervous system, but not the cells of the central nervous system.

Environmental conditions clearly determine the kind of cells into which the neural crest stem cells develop. Together with colleagues from Paris, the Freiburg- and Frankfurt-based scientists succeeded in demonstrating that, under modified conditions, these stem cells can also generate cells of the central nervous system. They exposed stem cells from the peripheral nervous system of embryonic or postnatal mice to different culture conditions. In addition to neurons, the neural crest stem cells also developed into different types of glial cells of the central nervous system, including oligodendrocytes and astrocytes. "The culture medium reprograms the neural crest stem cells in such a way that they change their identity. This worked without genetic modification of the cells," explains Hermann Rohrer from the Max Planck Institute for Brain Research.

Factors in the culture medium clearly activated a different genetic program so that cell types developed from the stem cells, which normally would not. The scientists do not yet understand the precise factors at work

here. However, there are some indications that fibroblast growth factor (FGF) is involved in this transformation.

In the brains of mice at different developmental stages, the reprogrammed stem cells mainly developed into oligodendrocytes, which form the myelin layer around the neurons of the central nervous system and are, therefore, indispensable for the transmission of electrical stimuli. Transplantation experiments carried out by the researchers on genetically modified mice that do not produce myelin and have severe neurological defects proved that the new oligodendrocytes can also assume this task. "The reprogrammed stem cells can form cells of the central nervous system, and the new cells can permanently integrate into this system," says Verdon Taylor of the Max Planck Institute of Immunobiology and Epigenetics.

It is not yet clear, to what extent these basic research findings will contribute to the development of cell therapy for humans. This would require that similar stem cells are present and accessible in the peripheral nervous system of humans, and that these can be propagated and reprogrammed in culture. "At present, we only know that these stem cells in mice also have the potential to produce oligodendrocytes," says Hermann Rohrer. The scientists would now like to investigate in greater detail which molecular mechanisms are responsible for the reprogramming of the stem cells, whether neural crest stem cells also exist in the peripheral nervous system of adult mice and what kind of conditions are required to enable the reprogramming of these cells.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Max-Planck-Gesellschaft**.

Journal Reference:

1. E. Binder, M. Rukavina, H. Hassani, M. Weber, H. Nakatani, T. Reiff, C. Parras, V. Taylor, H. Rohrer. **Peripheral Nervous System Progenitors Can Be Reprogrammed to Produce Myelinating Oligodendrocytes and Repair Brain Lesions**. *Journal of Neuroscience*, 2011; 31 (17): 6379 DOI: 10.1523/JNEUROSCI.0129-11.2011

http://www.sciencedaily.com/releases/2011/05/110512103948.htm

Oceanic Land Crab Extinction Linked to Colonization of Hawaii

Geograpsus severnsi, holotype male (USNM 539,738). (Credit: Gustav Paulay, John Starmer. Evolution, Insular Restriction, and Extinction of Oceanic Land Crabs, Exemplified by the Loss of an Endemic Geograpsus in the Hawaiian Islands. PLoS ONE, 2011; 6 (5): e19916 DOI: 10.1371/journal.pone.0019916)

ScienceDaily (May 23, 2011) — University of Florida researchers have described a new species of land crab that documents the first crab extinction during the human era.

The loss of the crab likely greatly impacted the ecology of the Hawaiian Islands, as land crabs are major predators, control litter decomposition and help in nutrient cycling and seed dispersal. Their disappearance was caused by the arrival of humans to the islands and resulted in large-scale changes in the state's ecosystem. Researchers said the full impact of the extinction on Hawaii is unknown, but they are certain it led to changes in the diversity of the food web, a continuing concern to conservationists studying species loss in other habitats. The study will be published online May 16 in *PLoS ONE*.

"If these land crabs were alive today, Hawaii would be a very different place," said lead author Gustav Paulay, marine malacology curator at the Florida Museum of Natural History on the UF campus. "They certainly were major ecological players, as they were very abundant, large, carnivorous omnivores."

Numerous fossils of the new species, Geograpsus severnsi, have been found on the major Hawaiian Islands for many years, but its identity was not clear. Researchers identified the crab by comparing physical characteristics with specimens from various collections. The species is unique to the Hawaiian Islands and the most land-adapted crab in the Pacific, expanding further inland and to higher elevations than any other. Like other island land crabs, G. severnsi appears to have retained ties to the sea, where its larvae developed.

Analysis of the radiocarbon-dated specimens show they vanished soon after Polynesians colonized the Hawaiian Islands about 1,000 years ago. Colonists brought novel predators to the islands, including lizards, rats, pigs, dogs and jungle fowls, profoundly altering coastal and low-elevation habitats, Paulay said.

"When people arrive on an island, initially it's like the Garden of Eden -- few people and lots of resources," Paulay said. "I can imagine a period when humans and the introduced rats, dogs and pigs would have preyed heavily on the crabs, especially during their mass migrations to release larvae in the ocean."

The sister species to G. severnsi, Geograpsus grayi, still lives on many Pacific Islands, so researchers can only speculate the exact cause of the extinction of G. severnsi, whose fossils are common on Hawaii, Maui, Oahu and Kauai. Oceanic land crabs occupy nearly all tropical islands, but many in the Pacific appear to be in decline from different causes.

"Islands have a limited habitat area, so that makes organisms on them inherently vulnerable," Paulay said. "Because islands are isolated, major groups of species, like mammals or ants can be absent. Thus, island species evolve in their absence and often can't cope when such continental predators are introduced."

As important predators of invertebrates, plants and even nesting sea birds, land crabs probably affected the establishment and shaped the evolution of many species on the islands, Paulay said. Geograpsus severnsi was the largest species of this carnivorous genus.

"A study like this can reveal what the structure of the natural ecosystem was before these human-caused ecological changes, and that's very important for moving forward with conservation," said Helen James, curator of birds at the Smithsonian Institution's National Museum of Natural History. "It highlights the complexity of the ecological changes that took place on the Hawaiian Islands and their severity in causing the extinction of a land crab."

One example of how crabs affect the ecology of islands can be seen on Christmas Island in the Indian Ocean, where the invasive yellow crazy ant is destroying crab populations of a different species of land crab.

"The loss of this crab from areas has led to change in the structure of the forest because the crabs controlled litter and ate the seedlings of weeds," Paulay said. "We don't know the full ecological impact of all these land crabs, but we know that on islands, it's usually substantial."

Because oceanic islands have never been connected to a landmass, species establishment is based entirely on dispersal, a process that likely allowed land crabs to spread more easily because they have a marine larval stage in their development. For terrestrial organisms, arrival is usually less likely so there are missing organisms and altered ecological conditions

Florida Museum doctoral malacology student John Starmer co-authored the study, funded by the National Science Foundation, the Leila & William Brayfield Scholarship and the Southwest Florida Fossil Club.

Story Source:

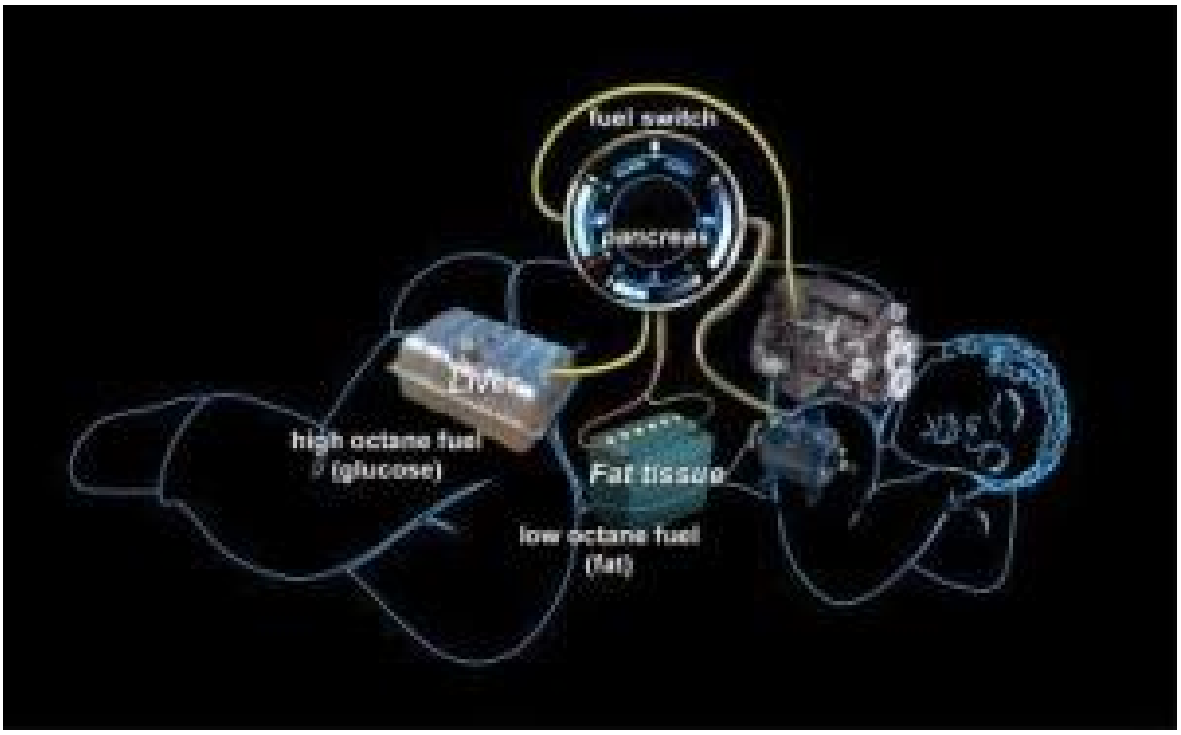
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Florida**. The original article was written by Danielle Torrent.

Journal Reference:

1. Gustav Paulay, John Starmer. **Evolution, Insular Restriction, and Extinction of Oceanic Land Crabs, Exemplified by the Loss of an Endemic Geograpsus in the Hawaiian Islands**. *PLoS ONE*, 2011; 6 (5): e19916 DOI: 10.1371/journal.pone.0019916

http://www.sciencedaily.com/releases/2011/05/110516181327.htm

Evolutionary Conservation of Fat Metabolism Pathways



The metabolic system functions like a hybrid car. In the daytime we use glucose as high octane fuel, but at night we switch to the battery, which in this case is stored fat. (Credit: Image: Courtesy of Dr. Marc Montminy and Jamie Simon, Salk Institute for Biological Studies.)

ScienceDaily (May 23, 2011) — By virtue of having survived, all animals-from flies to man-share a common expertise. All can distinguish times of plenty from famine and adjust their metabolism or behavior accordingly. Failure to do so signals either extinction or disease.

A collaborative effort by investigators at the Salk Institute for Biological Studies recently revealed just how similarly mammals and insects make critical metabolic adjustments when food availability changes, either due to environmental catastrophe or everyday changes in sleep/wake cycles. Those findings may suggest novel ways to treat metabolic conditions such as obesity and type II diabetes.

In a study published in the May 13, 2011, issue of *Cell*, co-investigators Marc Montminy, M.D., Ph.D, professor in the Clayton Foundation Laboratories for Peptide Biology, and John Thomas, Ph.D., professor in the Molecular Neurobiology Laboratory, use the fruitfly *Drosophila melanogaster* to show that activation of a factor called SIK3 by insulin dampens a well-characterized pathway promoting fat breakdown, providing a molecular link between glucose metabolism and lipid storage.

"The metabolic system is like a hybrid car. In the daytime we use glucose as high octane fuel, but at night we switch to the battery, which in this case is stored fat," says Montminy. "This new study shows how SIK3 promotes lipid storage during daytime feeding hours by blocking fat breakdown programs that normally only function during night-time fasting periods."

During fasting, a group of fat-busting enzymes, called lipases, trigger the flow of energy from the fly's low-power battery fat pack to different organs in the body. These lipases are turned on by a genetic switch, called FOXO, part of the central transmission for fasting metabolism. When the flies eat food, SIK3 shuts off the

FOXO switch, which both cuts off the battery's energy stream by silencing the fat-busting enzymes and allowing the "fat pack" to recharge its batteries.

Having teamed up previously to analyze pathways regulating glucose availability, Montminy, an expert in metabolism, and Thomas, a fly geneticist, focused on SIK3 in part because it is expressed in the fly fat body-a structure equivalent to mammalian adipose tissue and liver-but primarily because it is the Drosophila counterpart of a mammalian liver enzyme that antagonizes fat breakdown.

In experiments led by Biao Wang, Ph.D., a postdoctoral fellow in the Montminy lab and the paper's first author, the team mutated the Drosophila SIK3 gene, thereby disabling it, and monitored changes in fat metabolism. Mutant flies showed abnormally meager fat stores in the fat body and rapidly starved to death when deprived of food. "A normal fly can store enough fat to survive that period of food deprivation," says Thomas. "Flies in the wild lacking SIK3 would not make it from one feeding to the next."

That lack of fat was explained in part by the team's observation that SIK3 indirectly represses expression of a fat-burning enzyme active only in times of starvation. But the group immediately suspected that SIK3 was antagonizing a much bigger metabolic fish, namely a well-characterized "master regulator" known as FOXO, which in many organisms works in the nucleus to switch on genes that promote fat burning in times of nutrient deprivation.

Unexpectedly, SIK3 does not control the FOXO switch directly. Rather, much like a runner in a relay race, the SIK3 enzyme had to pass the baton to another enzyme called HDAC4, which in turn regulates FOXO.

"The complexity of this molecular machine likely reflects its importance in determining when the fat batteries should be turned on or off," says Montminy. "Indeed, perhaps the best argument for the importance of a group of molecules is that you see them doing the same thing over and over again in different organisms."

The investigators found that the SIK3/HDAC4/FOXO machine they had characterized in the fruitfly also controls the metabolic hybrid engine in mice. There, disabling one of these molecules in liver also disrupted the metabolic switch from fasting to feeding.

Ease of genetic manipulation makes flies a popular model organism for biological research. But ease was not the primary motivator of these studies. "Virtually all important components of the insulin pathway are conserved in flies and mammals," says Montminy. "Numerous human disease genes are expressed in Drosophila, and you can even mimic certain aspects of diabetes in fly models as well."

Thomas agrees, suggesting that metabolic similarities between flies and mammals exemplify mother nature's reluctance to improve on a good thing, especially when that good thing determines life or death. "The fact that these same pathways are used wholesale in flies and humans is quite striking," says Thomas. "A fly has to regulate its metabolism just like a human-if you create something during evolution that works well, it's likely going to remain conserved."

Unraveling SIK3/HDAC4/FOXO regulatory activity puts, as Thomas says, "more pharmacological possibilities on the table" in treating metabolic disease, an opinion echoed by Montminy.

"Currently, we have over 20 million people with type 2 diabetes and close to 60 million with insulin resistance," says Montminy. "This is a huge problem tied to obesity. Finding a way to curb obesity will essentially require consideration of both environmental and genetic factors. The human counterparts of HDAC4 and SIK3 may be mutated in ways that make them work less effectively and enhance our proclivity to become obese."

Other contributors to the work include Noel Moya and Wolfgang H. Fischer of Salk's Peptide Biology Laboratory; Reuben J. Shaw and Maria M. Mihaylova of Salk's Molecular and Cellular Biology Laboratory; and John R. Yates III, Sherry Niessen and Heather Hoover of The Scripps Research Institute in La Jolla.

Support for the work was provided by grants from the National Institutes of Health, the American Diabetes Association, The Kieckhefer Foundation, The Clayton Foundation for Medical Research, and The Leona M. and Harry B. Helmsley Charitable Trust.

Story Source:

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

Journal Reference:

1. Biao Wang, Noel Moya, Sherry Niessen, Heather Hoover, Maria M. Mihaylova, Reuben J. Shaw, John R. Yates, Wolfgang H. Fischer, John B. Thomas, Marc Montminy. **A Hormone-Dependent Module Regulating Energy Balance**. *Cell*, Volume 145, Issue 4, 596-606, 13 May 2011 DOI: 10.1016/j.cell.2011.04.013

http://www.sciencedaily.com/releases/2011/05/110512132414.htm

Freedom in the Swamp: Unearthing the Secret History of the Great Dismal Swamp

Students in the 2010 American University Dismal Swamp Field School excavating a probable 18th or 19th century maroon cabin footprint. (Credit: Dan Sayers, American University.)

ScienceDaily (May 23, 2011) — It's the year 1800. You're a slave in southeast Virginia. You manage to escape. Your freedom is only going to last as long as you can hide. Where do you go? Would you believe the Great Dismal Swamp? According to Dan Sayers, assistant professor of anthropology and an historical archaeologist at American University, that's exactly where you could have gone for immediate sanctuary.

"There are interesting parallels. What was once more of a human refuge is now a natural refuge," said Sayers of the swamp, which officially became the Great Dismal Swamp National Wildlife Refuge in the 1970s.

Since 2001, Sayers has been researching and exploring the presence of maroons (African-Americans who permanently escaped enslavement) and other communities in the swamp's approximately 200 square miles of undeveloped, densely wooded wetlands in southeast Virginia and northeast North Carolina.

The current swamp is only 10 percent of the 2,000 square miles it was before the Civil War. To conduct his archaeology research in the swamp, Sayers had to secure a federal permit from the U.S. Fish and Wildlife Service, the government agency that owns the swamp.

Aside from maroons, Sayers says the swamp was also home to Indigenous Americans (Native Americans), enslaved canal laborers (African-Americans who worked for the canal companies -- some worked to buy or earn their freedom), free African-Americans, and outcast Europeans, such as criminals.

Uncovering a Secret Human World

Sayers' research project, called the Great Dismal Swamp Landscape Study, recently secured a $200,000 We the People Award from the National Endowment for the Humanities.

It all began when Sayers decided to research the history of the Great Dismal Swamp from the 1600s through 1860 for his doctoral dissertation. From the beginning, Sayers discovered that he had his work cut out for him -- practically no field research had been done in the Great Dismal Swamp Refuge. Historic documents only offered hints alluding to the communities.

The dearth of information was so great that Sayers had to design his own landscape models -- carefully researched plans archeologists use to predict where a community might have been located, how big it might have been, and what elements would have been involved, depending on who lived there and when.

"Say I was researching the history of a 1840s Virginia farmhouse," Sayers posed. " Based on historic documentation and previous field research of other, similar properties, I would likely be able to tell you where the house was on the land (if no longer standing), where the outhouse, barn, and possibly enslaved people's quarters would have been in relation to the house without even putting a shovel in the ground."

To create his models, Sayers examined historic documentation and research about other, similar swamp communities in the Western Hemisphere, including those in Florida, Georgia, and Louisiana.

"In other areas, local militias were often hired to capture maroons and destroy their settlements," Sayers said. "When they found these communities, they would document the location of settlements, the sizes, shapes, and number of houses and other structures before destroying them."

The other swamps were nowhere near as dense or expansive as the Great Dismal Swamp, which is likely why so little documentation on the Dismal Swamp communities existed. Nobody who would have documented the Dismal Swamp communities had found them. It was truly a great hiding place.

The Importance of Secrecy, Security

For the past three summers, Sayers has taken a group of American University students to sites in the swamp for a field school through which they gain valuable experience in the craft of archaeology, including photography, mapping, soil sampling, and excavation. This summer's field school begins May 17 and ends July 2.

Sayers says the items unearthed during the past decade have been mundane, everyday items -- such as part of a broken bowl, a gunflint, a stone tool, or bone fragments of a butchered animal -- but they help tell the story of the people who lived there and how they interacted with each other and the outside world.

The communities largely formed in three areas: the swamp's outskirts, the swamp's secluded interior (away from the canals), or along the canals. Each type of community existed for different reasons.

People in the interior communities wished to be as isolated as possible and would have relied more on items they made by hand. Canal laborers, who lived in the communities along the canals, would have used more mass-produced items as they regularly interacted with the outside world.

Interior communities also would have had more interest in monitoring who joined or left their ranks. "Leaders were very cautious about who came in and who left," Sayers said. "Their central concern was protecting the community's secrecy and security."

Sayers says this summer's swamp field school site has the markings of a large community and that overall, possibly thousands of people lived in the swamp between the 1600s and 1860.

"Many of these began as communities of Indigenous Americans around the 1600s," Sayers said. "When maroons started taking refuge in the swamp around the1700s, they began joining existing communities and also likely formed their own."

According to Sayers, the artifacts indicate that the swamp communities began to dwindle around the 1860s close to the Civil War.

"There were likely some minor skirmishes in the swamp as well as a gradual but strong exodus of maroons over the course of 3 to 4 years to join the fight -- obviously for the North," Sayers said about the war's impact.

Challenges Worth the Effort

Swamp life wasn't easy for the people who sought refuge there and isn't easy for Sayers and his team. The swamp is called "dismal" for a reason -- in the summer, the heat and humidity are oppressive. Stinging, biting insects, snakes, and bears are among the wildlife. Then there are the brambles with "thorns the size of shark's teeth" cited by Sayers as the reason he wears a full canvas suit in the field every day.

But as dismal as swamp life is, the outcome is worth the effort.

"These groups are very inspirational," Sayers said. "As details unfold, we are increasingly able to show how people have the ability, as individuals and communities, to take control of their lives, even under oppressive conditions."

Story Source:

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

http://www.sciencedaily.com/releases/2011/05/110516075940.htm

Cover Crop Seeder Pulls Triple Duty for Small Farms

The multipurpose cover crop seeder prototype, designed and built by Penn State agricultural scientists, could save farmers $10 to $20 an acre by performing two to three operations at once. The seeder scores the soil, plants seed, adds herbicides and sprays fertilizer in a single trip. (Credit: Patrick Mansell, Penn State)

ScienceDaily (May 23, 2011) — Farmers using a cover crop seeder developed by Penn State agricultural scientists may eventually need only a single trip across the field to accomplish what takes most farmers three passes and several pieces of equipment to do.

Pennsylvania farmers are increasingly interested in growing cover crops, but the time, cost and late fall harvest of corn and other crops often limit their use, said Gregory Roth, professor of agronomy.

The seeder can help farmers, especially small operations, save time and money by condensing multiple tasks into one trip through a no-till field. It would also allow farmers to seed fields that lacked cover crops due to late season and cost concerns.

"It can do three things in one pass," Roth said. "It can seed the cover crop, add fertilizer and spray an herbicide to kill emerged weeds."

Unlike plowing, no-till farming uses a minimal amount of ground disturbance when planting seeds, a method that improves the soil and prevents erosion. Cover crops play an important role in reducing runoff and helping to build organic material in the soil during the fall and spring.

A tractor pulls the seeder through the cornfield rows using a sensor to guide the device between the rows. The device has several blades that lightly till the ground between the cornrows creating a planting swath. The seeds drop onto the soil and a follow-up roller packs the seed into place.

At the same time, the machine strategically applies a fertilizer and herbicide. The research team created a prototype using a number of existing technologies from agricultural equipment manufacturers.

According to Roth, the best time to use the device is six weeks after the corn is planted. If the cover crop is planted too early, it can compete with the corn plants; if it is planted too late, the corn crop may be too competitive for the cover crop to grow.

A single pass through a field costs the farmer approximately $10 an acre, Roth said. By saving one to two trips through the fields, farmers could save $10 to $20 per acre.

Other methods of planting cover crops during the growing season -- such as using an airplane to drop seeds on the field -- are expensive and only moderately successful. Roth said the alternative methods are only effective in establishing a cover crop about half the time.

The researchers tested the seeder last summer in three studies at Penn State's Russell E. Larson Agricultural Research Center, said William Curran, professor of weed sciences. In each of the studies, the crop seeder was successful in establishing cover crops without any impact on corn yields.

The researchers tested three cover crops -- annual ryegrass, red clover and white clover. They also tested a mixture of ryegrass and clover. Because ryegrass and clover can prevent soil erosion and serve as a natural source of nitrogen, farmers also may not need to purchase as much fertilizer.

"We picked cover crops that we thought would work and chose the ones that we thought had the best chance to be successful," Curran said.

The researchers said they are pleased with the results of the first tests, but have more work to do to perfect the seeder.

"We really had just one season for research and we basically tested things that we were pretty sure would be successful," said Curran. "Now we have to do more research before we feel the results are of value and we feel confident in what we're doing."

If the seeder is marketed, the researchers believe that the device will be inexpensive enough for use on smaller farms.

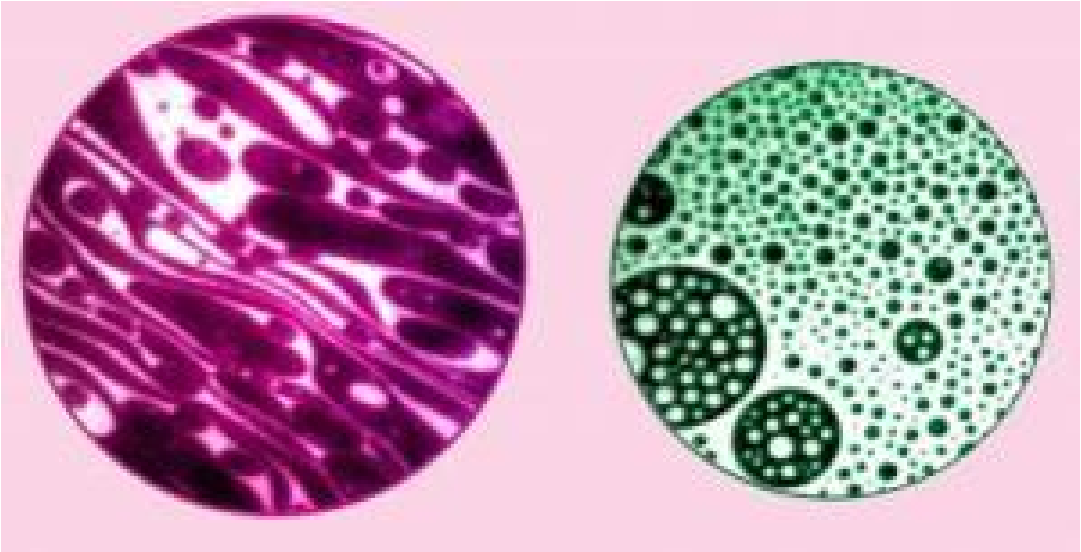
The researchers have filed a provisional patent on this device.

Story Source:

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

http://www.sciencedaily.com/releases/2011/05/110523161205.htm

New Nanoscale Imaging May Lead to New Treatments for Multiple Sclerosis



These are fluorescence images of lipid domains in model (laboratory reconstituted) myelin monolayers showing coexistence of liquid-ordered (dark) and liquid-disordered (pseudo-colored) phases. Depending on the conditions (e.g., liquid-disordered (pseudo-colored) phases. Depending on the conditions (e.g., lipid composition, surface pressure, temperature), the lipid domains can exist in various shapes including striped (left) and circular (right). (Credit: Images courtesy of Younjin Min, Massachusetts Institute of Technology)

ScienceDaily (May 23, 2011) — Laboratory studies by chemical engineers at UC Santa Barbara may lead to new experimental methods for early detection and diagnosis -- and to possible treatments -- for pathological tissues that are precursors to multiple sclerosis and similar diseases.

Achieving a new method of nanoscopic imaging, the scientific team studied the myelin sheath, the membrane surrounding nerves that is compromised in patients with multiple sclerosis (MS).

The study is published in this week's online edition of the *Proceedings of the National Academy of Sciences* (PNAS).

"Myelin membranes are a class of biological membranes that are only two molecules thick, less than one millionth of a millimeter," said Jacob Israelachvili, one of the senior authors and professor of chemical engineering and of materials at UCSB. "The membranes wrap around the nerve axons to form the myelin sheath."

He explained that the way different parts of the central nervous system, including the brain, communicate with each other throughout the body is via the transmission of electric impulses, or signals, along the fibrous myelin sheaths. The sheaths act like electric cables or transmission lines.

"Defects in the molecular or structural organization of myelin membranes lead to reduced transmission efficiency," said Israelachvilli. "This results in various sensory and motor disorders or disabilities, and neurological diseases such as multiple sclerosis."

At the microscopic level and the macroscopic level, which is visible to the eye, MS is characterized by the appearance of lesions or vacuoles in the myelin, and eventually results in the complete disintegration of the myelin sheath. This progressive disintegration is called demyelination.

The researchers focused on what happens at the molecular level, commonly referred to as the nanoscopic level. This requires highly sensitive visualization and characterization techniques.

The article describes fluorescence imaging and other measurements of domains, which are small heterogeneous clusters of lipid molecules -- the main constituents of myelin membranes -- that are likely to be responsible for the formation of lesions. They did this using model molecular layers in compositions that mimic both healthy and diseased myelin membranes.

They observed differences in the appearance, size, and sensitivity to pressure, of domains in the healthy and diseased monolayers. Next, they developed a theoretical model, in terms of certain molecular properties, that appears to account quantitatively for their observations.

"The discovery and characterization of micron-sized domains that are different in healthy and diseased lipid assemblies have important implications for the way these membranes interact with each other," said Israelachvili. "And this leads to new understanding of demyelination at the molecular level."

The findings pave the way for new experimental methods for early detection, diagnosis, staging, and possible treatment of pathological tissues that are precursors to MS and other membrane-associated diseases, according to the authors.

All of the work reported in the paper was completed at UCSB, although some of the authors have moved to other institutions. In addition to Israelachvili, the other authors are Dong Woog Lee, graduate student in UCSB's Department of Chemical Engineering; Younjin Min, now a postdoctoral fellow in the Department of Chemical Engineering at the Massachusetts Institute of Engineering; Prajnaparamitra Dhar, now assistant professor in the Department of Chemical Engineering at the University of Kansas; Arun Ramachandran, now assistant professor in the Department of Chemical Engineering and Applied Chemistry at the University of Toronto; and Joseph A. Zasadzinski, now professor in the Department of Chemical Engineering and Materials Science at the University of Minnesota.

Story Source:

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

Journal Reference:

1. Dong Woog Lee, Younjin Min, Prajnaparamitra Dhar, Arun Ramachandran, Jacob N. Israelachvili and Joseph A. Zasadzinski. **Relating domain size distribution to line tension and molecular dipole density in model cytoplasmic myelin lipid monolayers**. *PNAS*, May 23, 2011 DOI: 10.1073/pnas.1106368108

http://www.sciencedaily.com/releases/2011/05/110523152348.htm

Mechanism Behind Compound's Effects on Skin Inflammation and Cancer Progression Described

Dr. Chuck Dimitroff, Danielle Hays, Matt Opperman, Dr. Filiberto Cedeno-Laurent and Dr. Steve Barthel. (Credit: Image courtesy of Brigham and Women's Hospital)

ScienceDaily (May 23, 2011) — Charles J. Dimitroff, MS, PhD, and colleagues in the Dimitroff Lab at Brigham and Women's Hospital, have developed a fluorinated analog of glucosamine, which, in a recent study, has been shown to block the synthesis of key carbohydrate structures linked to skin inflammation and cancer progression.

These findings appear in the April 14, 2011, issue of the *Journal of Biological Chemistry*.

Dr. Dimitroff and colleagues show for the first time that the fluorinated glucosamine therapeutic works not through direct incorporation into growing sugar chains as previously believed but instead blocks the synthesis of a key sugar, UDP-GlcNAc, inside immune cells characteristically involved inflammation and anti-tumor immunity

Accordingly, this report underscores a novel and previously unknown mechanism by which fluorinated glucosamine analogs could shape and reduce inflammation intensity, while boosting anti-tumor immune responses. Such knowledge could prove valuable in the design of new and more potent glucosamine mimetics against disease as well as in treatment strategies to utilize existing glucosamine mimetics more efficiently.

This research was funded by grants from the National Cancer Institute and the National Center for Complementary and Alternative Medicine of the National Institutes of Health.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Brigham and Women's Hospital**.

Journal Reference:

1. S. R. Barthel, A. Antonopoulos, F. Cedeno-Laurent, L. Schaffer, G. Hernandez, S. A. Patil, S. J. North, A. Dell, K. L. Matta, S. Neelamegham, S. M. Haslam, C. J. Dimitroff. **Peracetylated 4-fluoro-glucosamine reduces the content and repertoire of N- and O-glycans without direct incorporation.**. *Journal of Biological Chemistry*, 2011; DOI: 10.1074/jbc.M110.194597

http://www.sciencedaily.com/releases/2011/05/110523121337.htm

Out of Africa: How the Fruit Fly Made Its Way in the World

Fruit flies in breeding containers. (Credit: Vetmed Uni Vienna / Wassermann)

ScienceDaily (May 22, 2011) — The fruit fly *Drosophila melanogaster* used to be found only in sub-Saharan Africa, but about 10,000 years ago it began to colonize Asia and Europe. This period saw the start of human agriculture and the domestication of cats and oxen, but we have no evidence to suggest that early agricultural practices were associated with significant global warming. So, the fly's northerly spread is thought to relate to genetic factors rather than to environmental changes.

An intriguing clue to the mechanism is now provided by Christian Schlötterer from the Institute of Population Genetics at the University of Veterinary Medicine, Vienna. His results are published in the journal *PLoS Genetics*.

Fruit flies that moved from sub-Saharan Africa found themselves confronted by conditions very different from those to which they were accustomed. Most obviously, the average temperatures were considerably lower and so it is no surprise that the flies had to adapt to cope with life in the north. As a result of thousands of years of evolution, populations in sub-Saharan African and in Europe now differ dramatically in a number of characteristics known to relate to temperature (such as pigmentation, size and resistance to cold). Schlötterer's previous work had suggested that a single gene, interestingly known as *cramped* (*crm*), might be involved in helping the flies survive in a colder environment but conclusive proof was lacking.

The *crm* protein is a transcription factor, so Jean-Michel Gibert in Schlötterer's laboratory decided to investigate what genes it could regulate, continuing to work on the project following his move to the University of Geneva. Gibert and Schlötterer focused in particular on genes known to be involved in wing development, such as the so-called *cubitus interruptus* (*ci*) gene, the regulation of which is known to depend on temperature. Satisfyingly, they were able to show that *crm* is absolutely required for the inactivation of the *ci* gene.

The scientists reasoned that if the *crm* protein is important in the response to temperature it should be possible to show that the variants -- or alleles -- of the *crm* gene found in Europe function differently from the alleles found in flies in sub-Saharan Africa. To "amplify" any differences in properties, they employed a sophisticated genetic trick, removing the effects of other sites in the fly's genome. In the presence of different *crm* alleles they examined the effects of temperature changes on the expression of the *ci* gene as well as on such characteristics as abdominal pigmentation in females and sex combs in males, traits known to be influenced by temperature. The results were striking: different *crm* alleles were associated with significant differences in the effects of temperature on these characteristics.

crm was found to limit distinct processes at different temperatures, strongly suggesting that changes in *crm* could have been involved in buffering the effects of different temperatures on the fly. The results represent an exciting new direction in the understanding of evolution. As Schlötterer says, "We normally imagine evolution proceeding by the acquisition of new functions. But the fly's adaptation to a colder environment seems instead to have been accompanied by changes to a master regulator to ensure that previously existing functions were retained despite the changed circumstances."

Story Source:

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

Journal Reference:

1. Jean-Michel Gibert, François Karch, Christian Schlötterer. **Segregating Variation in the Polycomb Group Gene cramped Alters the Effect of Temperature on Multiple Traits**. *PLoS Genetics*, 2011; 7 (1): e1001280 DOI: 10.1371/journal.pgen.1001280

http://www.sciencedaily.com/releases/2011/04/110427070859.htm

Engineers Scale Up Process That Could Improve Economics of Ethanol Production

Daniel Erickson, an Iowa State graduate student, uses a simple screen to harvest fungi from a pilot plant developed by a team of Iowa State University researchers. The reactor is the silver pipe to the right of Erickson. (Credit: Photo by Jeni Maiers/Center for Crops Utilization Research)

ScienceDaily (May 22, 2011) — Iowa State University's Hans van Leeuwen has moved his research team's award-winning idea for improving ethanol production from a laboratory to a pilot plant.

Now he knows the idea, which produces a new animal feed and cleans water that can be recycled back into ethanol production, works more efficiently in batches of up to 350 gallons than on a lab bench.

"We're learning we can reliably produce good quality and good quantities," said van Leeuwen, Iowa State's Vlasta Klima Balloun Professor of Engineering in the department of civil, construction and environmental engineering.

What van Leeuwen and a team of Iowa State researchers are producing is a fungus, Rhizopus oligosporus, that makes a high-quality, high-protein animal feed from the leftovers of ethanol production. The process of growing the fungus also cleans water from ethanol production so that it can be recycled back into fuel production. And the process, called MycoMeal, could one day produce a low-cost nutritional supplement for people.

The project has two patents pending and has won several major awards, including a 2008 R&D 100 Award presented by R&D Magazine, the 2008 Grand Prize for University Research presented by the American Academy of Environmental Engineers and a 2011 Honor Award in University Research from the academy. The project also contributed to R&D Magazine naming van Leeuwen its 2009 Innovator of the Year.

The research team working on the project is led by van Leeuwen and includes Nick Gabler and Mike Persia, assistant professors of animal science; Mary Rasmussen, a post-doctoral research associate in food science and human nutrition; Daniel Erickson, Christopher Koza and Debjani Mitra, graduate students; and Brandon Caldwell, a graduate of Iowa State. The project is supported by a three-year, $450,000 grant from the Iowa Energy Center and a Smithfield grant from the Office of the Iowa Attorney General. Lincolnway Energy of Nevada, Cellencor Corp. of Ames and Iowa State's Center for Crops Utilization Research and BioCentury Research Farm are also supporting the project.

Here's how their process works to improve dry-grind ethanol production:

For every gallon of ethanol produced, there are about five gallons of leftovers known as stillage. The stillage contains solids and other organic material. Most of the solids are removed by centrifugation and dried into distillers dried grains that are sold as livestock feed, primarily for cattle.

The remaining liquid, known as thin stillage, still contains some solids, a variety of organic compounds and enzymes. Because the compounds and solids can interfere with ethanol production, only about 50 percent of thin stillage can be recycled back into ethanol production. The rest is evaporated and blended with distillers dried grains to produce distillers dried grains with solubles.

The researchers add fungus to the thin stillage and it feeds and grows into a thick mass in less than a day -- van Leeuwen calls it "lightning-speed farming." The fungus removes about 60 percent of the organic material and most of the solids, allowing the water and enzymes in the thin stillage to be recycled back into production.

The fungus is then harvested and dried as animal feed that's rich in protein, certain essential amino acids and other nutrients. It can also be blended with distillers dried grains to boost its value as a livestock feed and make it more suitable for feeding hogs and chickens.

Van Leeuwen said the production technology can save United States ethanol producers up to $800 million a year in energy costs. He also said the technology can produce ethanol co-products worth another $800 million or more per year, depending on how it is used and marketed.

Now that the project has moved from a campus lab to the Iowa Energy Center's BECON facility in Nevada, van Leeuwen said researchers are working to improve the process at larger scales.

"We're adding and subtracting, doing things differently and redesigning our process all the time," he said.

Even so, the process has developed enough that researchers can use simple screens to harvest pellets of the fungus from the project's 20-foot high reactor. They're feeding some of the fungus to chickens and will soon start feeding tests with hogs. A next step could be testing the fungus for human consumption. (University leaders have tried the fungi and researchers regularly eat it, van Leeuwen said.)

As the project has successfully scaled up, so has van Leeuwen's optimism that the process could help the biofuels industry.

"Implementation of this process addresses criticism of biofuels by substantially lowering energy inputs and by increasing the production of nutritious animal feed," van Leeuwen said. "The MycoMeal process could truly revolutionize the biofuels industry."

Story Source:

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

http://www.sciencedaily.com/releases/2011/05/110520104832.htm

Octopuses Make Some Pretty Good Moves

This is the octopus at the Hebrew University who proved not only smart but agile in receiving rewards. (Credit: Hebrew University photo)

ScienceDaily (May 22, 2011) — In case you thought that octopuses were smart only in guessing the outcome of soccer matches (remember the late Paul the octopus in Germany who picked all the right winners in last year's world cup matches in Johannesburg?), scientists at the Hebrew University of Jerusalem have now shown that not only are they smart, they can make some pretty good moves as well.

Octopuses are among the most developed invertebrates. They have large brains and are fast learners. With eight arms and no rigid skeleton, they perform many tasks like crawling, swimming, mating and hunting. And unlike most animals such as humans -- who are restricted in their movements by a rigid skeleton which helps in determining the position of their limbs -- octopuses have limitless flexibility.

But because they have no such rigid structure, it was believed that the octopuses have only limited control over their eight flexible limbs. However, the Hebrew University researchers have shown otherwise. They developed a three-choice, transparent, plexiglass maze that required the octopus to use a single arm and direct it to a visually marked compartment outside of its tank of water that contained a food reward.

The octopuses in the experiment learned to insert a single arm through a central tube, out of the water, and into the correct marked goal compartment to retrieve the food reward. This success was dependent on visual information, which the octopuses were able to translate into a series of coordinated movements made by a single arm and retrieve the food. They were also able to repeat this process.

The completion of this task shows for the first time that an octopus can direct a single arm in a complex movement to a target location. Motor control issues, such as this, are the basis of an ongoing European Union research project aimed at building a "robot octopus." To understand how the octopus controls its movements, and to what extent it controls them, is therefore an important base for the design of the control architecture of a robot devoid of a rigid skeleton.

The research was reported on in a recent edition of *Current Biology*, and was authored by Tamar Gutnick, Prof. Binyamin Hochner and Dr. Michael Kuba of the Interdisciplinary Center for Neural Computation at the

Alexander Silberman Institute of Life Sciences at the Hebrew University, and Dr. Ruth A. Byrne of the Medical University of Vienna, Austria.

Story Source:

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

Journal Reference:

1. Tamar Gutnick, Ruth A. Byrne, Binyamin Hochner, Michael Kuba. **Octopus vulgaris Uses Visual Information to Determine the Location of Its Arm**. *Current Biology*, 2011; 21 (6): 460 DOI: 10.1016/j.cub.2011.01.052

http://www.sciencedaily.com/releases/2011/05/110518105513.htm

When Doctors Are Called to the Rescue in Midflight

By KATIE HAFNER

Dr. Matthew Rhoa is still haunted by one of his lowest moments as a physician. Several years ago, on the first leg of an international flight, he was just settling in for a nap when a flight attendant came on the public address system to ask, “Is there a doctor on the plane?”

Dr. Rhoa, who lives in San Francisco, didn’t push his call button. “As a gynecologist, I always waited for another doctor,” he said. “There’s never a need for a Pap smear at 30,000 feet.”

He fell asleep, only to be awakened an hour later by a second call for medical help. This time he answered, and at the back of the plane he found two anxious parents with their 18-month-old toddler, who had a cast on her broken leg and was crying inconsolably.

The girl’s toes were blue. Limbs can often swell in flight, and it was clear that the cast was much too tight. Dr. Rhoa slit the cast and pried it open. The girl stopped crying at once.

"I have been riddled by guilt to this day," said Dr. Rhoa, who now promptly answers every call for medical help on a plane. "I never want that feeling again of a kid suffering like that when I could have done something sooner."

Since the earliest days of commercial aviation, airlines have coped with medical emergencies in flight by calling on physicians who happen to be passengers. And as more people travel by air, the number of emergencies has risen accordingly.

"Passenger health is becoming more and more of an issue, because of increased life expectancy and more people flying with pre-existing conditions," said Dr. Paulo Alves, a vice president at MedAire, a company that provides crew members with medical advice from physicians on the ground.

MedAire, which advises more than 60 airlines around the world, managed about 19,000 in-flight medical cases for commercial airlines in 2010. Although few were life-threatening, 442 were serious enough to require diverting the plane — and 94 people died onboard.

The numbers reflect a fraction of the actual number of in-flight emergencies. The Federal Aviation Administration does not track in-flight medical episodes, and airlines are not required to report them.

Airborne calls for medical assistance pose a singular challenge for physicians, who find themselves suddenly caring for a stranger whose history they don't know, often with a problem well outside their specialty, in a setting with limited equipment but no shortage of onlookers scrutinizing their every move.

And they do this for no compensation. (The fact that Good Samaritan laws generally protect them from lawsuits is a small saving grace.)

So it is little wonder that many physicians hesitate before responding to an emergency call.

Three years ago, Dr. Peter Freed, a psychiatrist in Manhattan, answered a call for a physician during a cross-country flight. A passenger had just had a seizure. Dr. Freed told the flight attendant he had not practiced general medicine since his residency. Still, he was the only doctor to respond, and the flustered crew member told him she was grateful for any help at all.

The passenger, a woman in her 30s traveling from Europe, told Dr. Freed she had a longstanding seizure disorder. He had her take her medication and remained with her, hoping she would be fine for the rest of the flight. But after another 20 minutes, she developed the uncontrollable shaking of a grand mal seizure and fell unconscious.

He asked to speak to a neurologist on the ground, and within minutes the pilot was able to get one on the radio. But as Dr. Freed recalled, he was barred from the cockpit for security reasons and could not speak directly with the specialist.

"I talked to the flight attendant, who talked to the captain in the cockpit, who talked to the doctor," he said.

Next came the question that many physicians who answer in-flight emergency calls face: Should the plane be diverted to a nearby airport? Ultimately, the decision rests with the pilot, but the pilot looks to the medical expert for guidance. And it is a decision that other passengers await most anxiously.

After calculating that it would take as long to divert the plane as to reach their destination, Dr. Freed decided against it.

Once the plane landed, an emergency medical team whisked the woman away. The pilot had Dr. Freed stand with him while passengers disembarked. As people filed past, they shook Dr. Freed's hand and thanked him. But while that response was gratifying, the episode still felt unresolved.

"Doctors typically like to hear how cases end," Dr. Freed said. "But I didn't hear a thing. I never even knew her name. I still think about her."

Physicians are not completely without backup in an airborne emergency. The F.A.A. requires that flight attendants undergo CPR training and that all United States airlines carry emergency medical kits and automated external defibrillators.

But physicians who get a firsthand look at the kits say the contents vary.

"With some planes, it's a hospital in a box, and they have everything you could ever want," said Dr. Paul Abramson, a primary care physician in San Francisco. "But often they look like they've been picked over."

Dr. Abramson said one kit he was given had implements for ventilating a patient unable to breathe, but no bag to push air into the patient — a situation akin to having a gasoline nozzle and tank, but no fuel.

Another kit contained only enough intravenous saline solution to rehydrate a baby, not the 200-pound man he was tending.

Dr. Paul Sullam, a faculty member at the University of California, San Francisco, said he was on a plane several years ago when a passenger seemed to be having a heart attack.

The crew asked passengers if anyone had nitroglycerin tablets, small pills that are placed under the tongue to improve blood flow to the heart. No one responded. But when it asked for Valium, to calm the patient, "a forest of hands went up," Dr. Sullam recalled.

The lack of standardization was criticized in a recent article in The Journal of the American Medical Association. The paper argued not only that the medical kits should be standardized, down to the number of latex gloves, but also that a method for reporting incidents should be consistent among all airlines.

"Aviation is held up as this paragon of safety, yet here's this nasty thing that happens with no standard for reporting," said one of the article's authors, Dr. Melissa Mattison, associate director of hospital medicine at Beth Israel Deaconess Medical Center in Boston. "We know more about animals that die on airplanes than we do about people."

Dr. Abramson, the San Francisco physician, has answered so many emergency calls on planes that he now carries some basic medications in his toiletries bag whenever he flies, including antihistamines, prednisone, sedatives and painkillers, all "just in case they don't have it."

He also books his flights with "Dr." in front of his name. "That's so that if I'm asleep, they might wake me," he said. And he doesn't take sleeping pills or drink alcohol in flight. "The last thing you want to do is be woken up and not be with it," Dr. Abramson said.

"I kind of like doing it," he continued. "Because it's what I do, and it seems helpful, and it's interesting to make do with whatever minimal resources you have."

Dr. Abramson occasionally receives letters of thanks from the airline, and once received a free domestic ticket. "That was the best," he said.

Dr. Sullam, of U.C.S.F., said United Airlines once showed its gratitude by sending him an Arnold Palmer putter. “They must have figured all doctors play golf,” he said. (He does not, but he still has the putter.)

Dr. Celine Gounder, an infectious disease specialist at Johns Hopkins who works in global public health, has answered numerous emergency calls on flights. After one such call, she was given a bottle of Champagne as she left the plane to rush for a connecting flight.

“I thought, ‘What am I supposed to do with this?’ ” she recalled. She returned it to a flight attendant.

Despite the pressures, the haphazard nature of the work, the lack of compensation and the risks, physicians continue to reach up and answer the call. In a world of insurance forms, rushed office visits and ubiquitous technology, many count such emergency calls among the purest expressions of their Hippocratic oath.

“You feel good about trying to help someone, and that’s the most important thing,” said Dr. Ingrid Katz, an infectious disease specialist at Brigham and Women’s Hospital in Boston. “But don’t expect anything. It’s solely for the benefit of the person in need.”

http://www.nytimes.com/2011/05/24/health/24doctors.html?_r=1&nl=health&emc=healthupdateema2

On Your Marks, Get Set, Measure Heart Health

By TARA PARKER-POPE

Stuart Bradford

How fast can you run a mile?

For people in midlife, this simple measure of fitness may help predict their risk of heart problems as they age.

In two separate studies, researchers from the University of Texas Southwestern Medical School and the Cooper Institute in Dallas analyzed fitness levels for more than 66,000 people. Over all, the research showed that a person's fitness level at midlife is a strong predictor of long-term heart health, proving just as reliable as traditional risk factors like cholesterol level or high blood pressure. The two reports were published last month in Circulation and The Journal of the American College of Cardiology.

In the studies, fitness was measured using carefully monitored treadmill testing to gauge cardiovascular endurance and muscle fatigue. But in analyzing the data, the researchers suggested that the treadmill results could be translated to average mile times, offering a simple formula for doctors and individuals to rate their fitness level at midlife and predict long-term heart risk.

"When you try to boil down fitness, what does fitness mean?" said Dr. Jarett D. Berry, assistant professor of internal medicine and cardiology at Southwestern Medical School and a co-author of both papers. "In both these studies, how fast you can run in midlife is very strongly associated with heart disease risk when you're old. The exercise you do in your 40s is highly relevant to your heart disease risk in your 80s."

Dr. Berry cautioned that more study is needed before mile times could be used as an accepted benchmark of cardiovascular risk. Still, he noted that the pace at which a person runs is a measure of fitness to which people can easily relate, and a good starting point for measuring overall fitness.

From the study data, Dr. Berry calculated that a man in his 50s who can run a mile in 8 minutes or less, or a woman who can do it in 9 minutes or less, shows a high level of fitness. A 9-minute mile for a man and 10:30 for a woman are signs of moderate fitness; men who can't run better than a 10-minute mile, and women slower than 12 minutes, fall into the low-fitness category.

The categories make a big difference in risk for heart problems, the study found: Subjects in the high-fitness group had a 10 percent lifetime risk, compared with 30 percent for those in the low-fitness group.

Dr. Berry notes that fitness varies greatly with age and sex, and that mile-time estimates are just easy benchmarks for patients and doctors to begin a discussion about fitness. Over all, he said, a 10-minute mile for a middle-aged man and a 12-minute mile for a woman suggest a good level of fitness.

"The principal finding of these studies is that your fitness level when you're young is highly predictive of heart disease risk 30 to 40 years later," he said. "If we're trying to boil this down into practical implications, it's the speed at which you can run. Heart disease risk increases markedly for every minute longer it takes you to run a mile."

Dr. Timothy Church, a professor at the Pennington Biomedical Research Center in Baton Rouge, La., said more research was needed to validate the notion that a person's mile time correlates with the risk categories in the original study. But he agreed that exercise experts needed to come up with a better way to communicate exactly what fitness represents.

"You can't look at someone and judge whether or not they are fit," said Dr. Church. "What is fitness? From a risk-factor standpoint, it's about avoiding low fitness."

And he sounded another note of caution about the mile-time benchmarks. "I'm nervous about people testing fitness on their own," he said. "I don't want a 45-year-old sedentary male to go out and run a mile as fast as he can."

Even so, Dr. Church noted that most of the health benefits of exercise come with moving from low fitness to moderate fitness, and the challenge is finding a way to communicate with and motivate people in the low-fitness category.

"You know whether you're in the unfit category," he said. "If you're physically inactive, if you sit 18 hours a day, if you get exhausted walking up a flight of stairs. If you've got a choice between walking two blocks or taking a taxi and you wait 20 minutes to take a taxi, you're unfit."

Dr. Berry agreed that mile-time benchmarks might not be good indicators for every individual, given that some highly fit people have physical limitations that prevent them from running fast. The larger issue, he said, is that most people don't have a clear sense of where they fall on the fitness spectrum, and don't appreciate the risks that poor fitness poses for overall health.

Even people who take regular walks three times a week may have an inflated sense of their level of fitness, he said, adding, "You're meeting the guidelines for physical activity, but you're not necessarily fit."

While modest levels of exercise are better than nothing, he went on, "getting off the couch is the first step, but vigorous activity has a much more dramatic effect on fitness level."

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http://well.blogs.nytimes.com/2011/05/23/on-your-marks-get-set-measure-heart-health/?nl=health&emc=healthupdateema2

A Muse in the Machine: Click. Create.

By ROBERTA SMITH

It seems almost unnecessary to introduce Cory Arcangel, the digital wunderkind, artist-musician and inveterate hacker whose exhibition, "Pro Tools," has opened at the Whitney Museum of American Art.

In the ramp-up to the show Mr. Arcangel achieved something of a journalistic triple crown: profiles in New York magazine, The New Yorker and the Arts & Leisure section of The New York Times. These pieces detailed his early fascination with television and computers; his undergraduate years at Oberlin College, where he switched his focus from classical guitar to technology in music; his love of obsolete electronic equipment and programs; and the splash he made in the 2004 Whitney Biennial with "Super Mario Clouds v2k3."

Projected on four walls of a small gallery, this work consisted of a hacked program of the Super Mario Brothers video game, scrubbed clean of everything but its background: the puffy white clouds pulsing along on a pixelated blue sky. Its quietly animated fusion of Pop, Minimalism and giddy innocence was one of the exhibition's high points.

But Mr. Arcangel's Whitney solo turn does not quite live up to its advance attention. For one thing, it too seems a trifle scrubbed clean, sanitized and austere. Containing work almost entirely from 2011, it tells us little of his funkier early digital efforts, or artistic development. A few pieces reflect his longstanding interest in television and video games; in others he tries too hard to establish his formalist bona fides wryly with riffs on abstract painting and sculpture.

The Arcangel show, organized by Christiane Paul, the museum's adjunct curator of new media arts, has the Whitney trending young, hip and fashion forward, if a bit skimpy. Mr. Arcangel, who just turned 33, is the youngest artist since Bruce Nauman in 1973 to be accorded an entire floor at the museum. Yet, like the Whitney's small lobby shows, this effort comes with only with a brochure, not a thick catalog. No big case for greatness is posited; we're just being shown some fresh, new art, barely six months of work. Signaling modesty and flexibility, the Whitney has momentarily shifted to alternative-space mode, which may be the perfect gesture for the week when it also broke ground for its new downtown home in the meatpacking district.

As seen here Mr. Arcangel comes across as an artist who has parlayed his interest in electronic gadgetry and his infatuation with past avant-gardes into a low-affect art-about-art that too often flickers to fragile life only after you've ingested a dry, didactic wall label. The pieces on view are full of savvy echoes of early video art and structuralist film; kinetic, Conceptual and Pop art and their current derivatives; abstract painting; and, above all, appropriation art — all of it often updated by his generation's democratic attitude toward information sharing.

In that spirit three invisible works of art — identified by labels only — indicate that Mr. Arcangel has persuaded the Whitney to liberalize gallery conditions. The museum has suspended its prohibition of photography and let Mr. Arcangel boost cellphone reception and introduce Wi-Fi for computers, whose uses are normally verboten. This means that using such devices in the exhibition makes you part of a nominally participatory artwork. It also potentially underscores art as a momentary distraction, photo op or tweeting topic in a world of ever-shortening attention spans.

The show's opening gallery is in many ways the best. The space is dominated by "Various Self Playing Bowling Games (a k a Beat the Champ)," a large-scale video work that asserts a virtual storm of light, noise and flashing images via six cheek-to-jowl projections of video bowling games, from the late 1970s to the 2000s, all altered so that the bowlers throw nothing but gutter balls. The label intones that the piece "highlights the absurdities of simulating a physical experience in a virtual environment" and that the parade of failure "undermines both our expectations of technology and its promise of progress."

But the work's most gripping aspect is its ever-sharper depiction of human emotion; the piece inadvertently mimes a kind of dawning of modern consciousness and existential despair by charting the evolution from the player as a pre-Pac-Man grunt, barely differentiated from the bowling ball itself, to a relatively realistic tantrum thrower, who collapses or pounds the floor after each failed bowl, like one of Mr. Nauman's furious frustrated clowns. The piece is also an anarchic reprise of the buttoned-down anthropological parsings of early-1980s Pictures art, especially 'Richard Prince's sequences of similarly posed models from ads for watches, jewelry or cigarettes.

In an opposite corner "Research in Motion (Kinetic Sculpture #6)" rehearses the old saw about the similarity between modern abstract sculpture and commercial design with a series of "dancing stands" typically used in supermarket displays, but here conjuring, according to the label, the grids of Sol LeWitt. Whatever. The sight of them swiveling silently but weirdly in sync with the tumult of the bowling piece is among the show's nicer moments. Nearby a small monitor flashes and scrolls horizontal bands of intense color, from thick to thin to static, recalling Joan Jonas's early experiments with vertical roll and Paul Sharits's intensely chromatic flicker films.

Punchy abstract color briefly holds sway in the second gallery, where 10 large, bright "Photoshop Gradient Demonstrations" evoke a kind of lurid cross between Color Field painting mistiness and Op Art harshness. As the title implies, these seven-foot-tall prints were made in Photoshop with a few clicks of the mouse, using pixel coordinates that are generously included in the individual titles; anyone can make them. As with the Mario cloud piece, these works bring forward and isolate background motifs, in this case ones that are frequently used in commercial art. Recalling photographs by Thomas Ruff and Mr. Prince, the ensemble makes a nice surround, but it is hard to imagine actually living with one of these hyper-slick pieces.

Similarly it is difficult to imagine that the thousands of people who apparently downloaded Mr. Arcangel's code for hacking the clouds-only version of the Super Mario Brothers game will find much to like in this show. There's too much inside baseball. In one gallery a label informs us about the details of seven new pairs of Oakley M Frame sunglasses on a snazzy display stand: Mr. Arcangel has replaced the frames with painted bronze, seemingly parodying a certain art-world mania for hard-to-discern realistic casting. Nearby 10 boxes for Vizio 55-inch high-definition flat-screen TVs are double-stacked to form a long, low partition. This piece's title, "Volume Management," refers to computer storage systems while also slyly suggesting a new label for Minimalism, with its emphasis on boxy voids of space.

The label reveals that the screens are still in the boxes, conjuring Jeff Koons's early 1980s appropriation sculptures, which consisted of fresh-out-of-the-box 'vacuum cleaners presented in hermetically sealed, expertly lighted Plexiglas vitrines, like the expensive art objects that they soon became. Mr. Arcangel dispenses with the visual formalities, leaving everything to the imagination.

The inadvertent humanism of the bowling piece occasionally reasserts itself, albeit in routine feats of bravura editing. "There's Always One at Every Party" is a compilation, or a "supercut," of all the scenes from "Seinfeld" concerning Kramer's dream of doing a coffee-table book about coffee tables, pulling taut a thematic thread, ripe with Conceptualist self-reference and a kind of artistic delusion, that wandered through several episodes. "Paganini Caprice No. 5" reconstructs the well-known virtuoso work by Niccolò Paganini, the 19th-century violinist and composer, by grabbing individual notes from YouTube videos of amateur heavy-metal guitarists who frequently play the piece as a test of skill; it also creates a sweet, rapid-fire group portrait of music-driven souls whose dreams of stardom rarely materialize.

But too often this show stalls in slight or incomprehensible works: 40 drawings, done with a relatively antique pen-plotter printer, that resemble angular Jackson Pollock scribbles; five innocuous wire sculptures made by computer-operated machines used in the manufacture of metal furniture and display racks; and a final wall painted in the custom-mixed color Jay-Z Blue, a reproduction of the color that, according to the wall label, was "featured on a GMC Yukon Denali S.U.V. displayed at the North American International Auto Show in 2007."

Mr. Arcangel seems guided by a somewhat callow faith in the avant-garde, striving to perpetuate its tradition, dating from Duchamp, of laying claim to new areas of nonart for art's sake. Sometimes he succeeds, but sometimes he falls short, at which point it is perfectly O.K. to reach for your cellphone.

"Cory Arcangel: Pro Tools" runs through Sept. 11 at the Whitney Museum of American Art; (212) 570-3600, whitney.org.

http://www.nytimes.com/2011/05/27/arts/design/cory-arcangels-pro-tools-at-the-whitney-review.html?ref=design

An Architect's Fear That Preservation Distorts

By NICOLAI OUROUSSOFF

Has preservation become a dangerous epidemic? Is it destroying our cities?

That's the conclusion you may come to after seeing "Cronocaos" at the New Museum. Organized by Rem Koolhaas and Shohei Shigematsu, a partner in Mr. Koolhaas's Office for Metropolitan Architecture, the show draws on ideas that have been floating around architectural circles for several years now — particularly the view among many academics that preservation movements around the world, working hand in hand with governments and developers, have become a force for gentrification and social displacement, driving out the poor to make room for wealthy homeowners and tourists.

Mr. Koolhaas's vision is even more apocalyptic. A skilled provocateur, he paints a picture of an army of well-meaning but clueless preservationists who, in their zeal to protect the world's architectural legacies, end up debasing them by creating tasteful scenery for docile consumers while airbrushing out the most difficult chapters of history. The result, he argues, is a new form of historical amnesia, one that, perversely, only further alienates us from the past. "Cronocaos" was first shown at the 2010 architecture biennale in Venice, the ultimate example of what can happen to an aged city when it is repackaged for tourists. In New York the show is housed in a former restaurant-supply store next to the museum on the Bowery, in a neighborhood where the threats to urban diversity include culture as well as tourism. The Bowery's lively bar scene has been pushed out by galleries and boutiques. CBGB, the former rock club, is a John Varvatos store.

To highlight this transformation, Mr. Koolhaas and Mr. Shigematsu have kept the supply store's yellow awning, painting the show's title directly over the old lettering. Inside, the architects drew a line down the middle of the space, transforming one side into a pristine white gallery and leaving the other raw and untouched.

The result is startling. The uneven, patched-up floors and soiled walls of the old space look vibrant and alive; the new space looks sterile, an illustration of how even the minimalist renovations favored by art galleries

today, which often are promoted as ways of preserving a building's character, can cleanse it of historical meaning. (To sharpen the contrast further, Mr. Koolhaas scattered a few beat-up tables and chairs, salvaged when CBGB was closed five years ago, throughout the room.)

This has become a global phenomenon. All over the world, historic centers are being sanitized of signs of age and decay, losing any sense of the identity that buildings accumulate over time. Facades are carefully scrubbed clean; interiors, often blending minimalist white walls and a few painstakingly restored historic details, are reduced to a bland perfection. And new buildings are designed in watered-down period styles, further eroding the distinction between what's real and what's fake, and producing what Mr. Koolhaas calls a "low-grade, unintended timelessness."

Mr. Koolhaas argues that this process continues to spread. Using an assortment of graphs and charts, he claims that 12 percent of the earth's surface has already been landmarked by groups like Unesco, and that figure is expected to rise steeply in the near future. What's more, the age of what is being preserved continues to shrink. In the late 19th century only ancient monuments received legal protection; today buildings that are 30 years old are regularly listed as historic sites. (Mr. Koolhaas's own architecture is part of this trend. A house he designed in Bordeaux, France, was declared a national monument only three years after its completion in 1998.)

This phenomenon is coupled with another disturbing trend: the selective demolition of the most socially ambitious architecture of the 1960s and '70s — the last period when architects were able to do large-scale public work. That style has been condemned as a monstrous expression of Modernism.

In Germany monuments like the Palast der Republik, whose government offices, restaurants and nightclubs were once the social heart of East Berlin, became shorthand for a period many West Germans wanted to forget. Kisho Kurokawa's 1972 capsule tower, one of the most radical housing experiments built in postwar Japan, lies in a state of ruin, awaiting demolition. To Mr. Koolhaas, these examples are part of a widespread campaign to stamp out an entire period in architectural history — a form of censorship that is driven by ideological as much as aesthetic concerns. The New Museum show is essentially a manifesto, of course, but what saves it from becoming pure polemic is that Mr. Koolhaas is a first-rate architect as well as an original thinker. Some of the best parts of the show involve his efforts to find ways out of this mess.

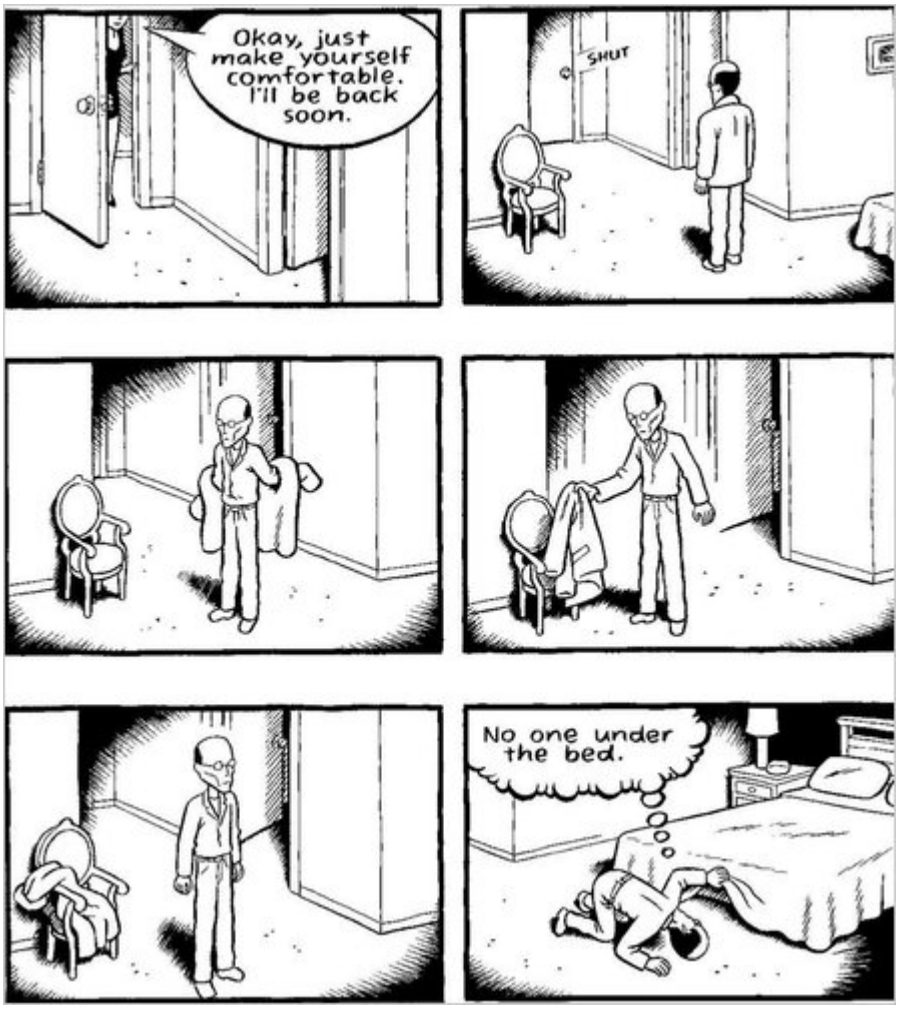
A 1995 competition design for an expansion of Zurich international airport sought to make sense of what had become a confusing labyrinth of mismatched terminals built over several decades. Rather than tear down the existing structures, Mr. Koolhaas proposed filling in leftover spaces between them with centralized entrance halls and new retail zones. He then created a circulation route to tie it all together. The experience would have been more like traveling though a real city than through a conventional airport. By keeping the various historical layers intact, and playing up their differences, he aimed to breathe new life into a dead environment. (The plan was rejected.) In another, more extreme proposal, from 2003, Mr. Koolhaas suggested creating preservation sectors in Beijing, in which everything from traditional hutongs to postwar Communist housing blocks would be protected, along with the way of life they housed. The rest of the city would be a kind of free-for-all, where planners and architects could experiment with new ideas and urban strategies without the crushing burden of history. Not all of his ideas are viable; some seem intended mainly to challenge conventional wisdom about preservation and its benefits, and in doing so, to liberate architecture just a little from stale ideas. Yet Mr. Koolhaas's bigger point is worth paying attention to: in the realm of preservation, as in so much else, we seem to have become a world terrified of too much direct contact with reality.

"Cronocaos" is on view through June 5 at the New Museum, 235 Bowery, at Prince Street, Lower East Side; (212) 219-1222, newmuseum.org.

http://www.nytimes.com/2011/05/24/arts/design/cronocaos-by-rem-koolhaas-at-the-new-museum.html?ref=design

A Graphic Memoir That Earns the Designation

By DWIGHT GARNER
PAYING FOR
IT The New York Times **May 25, 2011**



A Comic-Strip Memoir About Being a John

By Chester Brown

Illustrated. 280 pages. Drawn & Quarterly. $24.95.

Book titles are a touchy subject for writers. It's not rare to hear an author complain in private about one of his or hers, and ache to reach back in time to swap it for something else. A different title for a fizzled book might have meant a different life for it.

What's rare is to witness a writer complaining about his book's title inside the very book the title is stamped upon. That's what happens in "Paying for It: A Comic-Strip Memoir About Being a John," by the Toronto cartoonist Chester Brown.

Mr. Brown's illustrated memoir is exactly what it sounds like, a frank and guileless account of his predilection for paying women to have sex with him. Like some Mars-bound rockets, "Paying for It" burns in three stages: It's a factual and often graphic recounting of the author's many erotic sessions with sex workers; it's a bitter critique of the inanities of romantic love; and it's a sustained argument in favor of decriminalizing prostitution.

This is not a feel-good comic book. It's sober and intense, as if written by a lonely and homely Lou Reed and meant to be read aloud beneath a single light bulb hung from the ceiling. But it delivers a series of moral and cerebral and horndog thwacks. It will stick in your mind and perhaps in your craw. It's a real if squeamish-making work of art.

The idea to call this book "Paying for It" came from Mr. Brown's publisher, Drawn & Quarterly, the venerable Montreal comics house. Drawn & Quarterly didn't force the title on Mr. Brown, but he felt he should heed its editorial advice. After all, he admits, "this is a difficult book to market."

What he dislikes about the title, he says, is its implied double meaning, the suggestion that he's paying for his actions in some nonmonetary — some emotional or ethical — fashion. That's absurd, he declares. The comfort of strangers has made him quite happy, or at least much less miserable.

"I'm very far from being sad or lonely," he writes. "I haven't caught an S.T.D., I haven't been arrested, I haven't lost my career, and my friends and family haven't rejected me (although I should admit that I still haven't told my step-mom)."

Mr. Brown, whose previous books include "Louis Riel" (2003), a comic-book biography of a 19th-century Canadian political agitator, is 51. He began sleeping with prostitutes, he tells us, in his late 30s. Skinny, balding and ill at ease, he was never very successful with women. After a series of unhappy relationships, he decided he was through with romantic love. He wanted sex yet not a girlfriend. As far as love and fellow feeling were concerned, friends and family were enough.

"The romantic love ideal is actually evil," Mr. Brown declares, casually tossing a thunderbolt. It promotes "more misery than happiness" and causes many people to yoke themselves for life to the wrong person simply to satisfy society's dictates. His ego is not so fragile, he says, that he needs someone to tickle him like a stuffed animal and affirm that he's lovable.

After some trepidation, Mr. Brown begins to schedule daytime sessions with prostitutes who have advertised online or in alternative weeklies. We meet a shaggy parade of them: There are Carla and Susan and Jolene and Beatrice and Larissa and Millie and others in between. These are not of course their real names, and Mr. Brown never shows us their faces, which he tucks just out of the frame or behind caption bubbles; usually their backs are turned.

Mr. Brown intends to be true, warts and all, to his experience of these interactions. He's honest about what he desires in bed (nothing outlandish) and about his own fears and those of the women he patronizes. There is plenty of straight talk about intercourse, even if his stylized black-and-white drawings are mostly PG-13- or R-rated, not XXX.

In the panels depicting sex acts, the women tend to look lovely, while Mr. Brown — with his tight, unsmiling mouth; bald head; and long, thin body — resembles a praying mantis with testicles.

He can be bleakly funny. He opens a door at one small brothel, expecting to find a familiar face. “What? That’s not Angelina!” he thinks. “It’s a monster in a mini-skirt!” More often he is off-putting. There’s some bravery in his willingness to show himself in a vaguely creepy light.

“She’s a bit too old,” he thinks to himself, when told a certain woman is all of 28. He suggests in one of 23 appendices (which come before the footnotes) that “prostitution is just a form of dating.” He admits that he’s slightly turned on by the prostitute who keeps saying, “Ow,” during sex, even though she claims she’s not in pain. I cringe even to type that sentence.

Most of his encounters he finds to be pleasant, however. The first one makes him feel “exhilarated and transformed.” He writes, “A burden that I had been carrying since adolescence had disappeared.”

Mr. Brown’s arguments in favor of legalizing prostitution are honed in a series of running conversations with his friends, mostly fellow cartoonists, who function as this book’s wise-guy geek chorus. When one, hearing an online review of a prostitute, says, “This is too disturbing,” Mr. Brown replies, “How can this be disturbing for someone who watches porn almost 24 hours a day?”

He sorts through all the legal, emotional and moral arguments against prostitution. He quotes experts; his book contains a plump bibliography. He considers — and largely if not entirely dismisses — concerns about troubling issues like sex slavery, thieving pimps and abuse. These things sicken him, but he thinks they are sensationalized and, at any rate, have nothing to do with his own and most people’s experience of paid sex.

“I’ll bet I’m close to what the typical john is like,” he says to a female friend. “I’ll bet a lot of johns are mild-mannered introverts — guys who would never even consider assaulting anyone.”

Mr. Brown’s fundamental pro-prostitution argument — he considers it a feminist one — is not dissimilar to one put forward by the political philosopher Martha Nussbaum in the wake of the 2008 call-girl scandal that forced Gov. Eliot Spitzer of New York to resign.

“The idea that we ought to penalize women with few choices by removing one of the ones they do have is grotesque, the unmistakable fruit of the all-too-American thought that women who choose to have sex with many men are tainted, vile things who must be punished,” Ms. Nussbaum wrote.

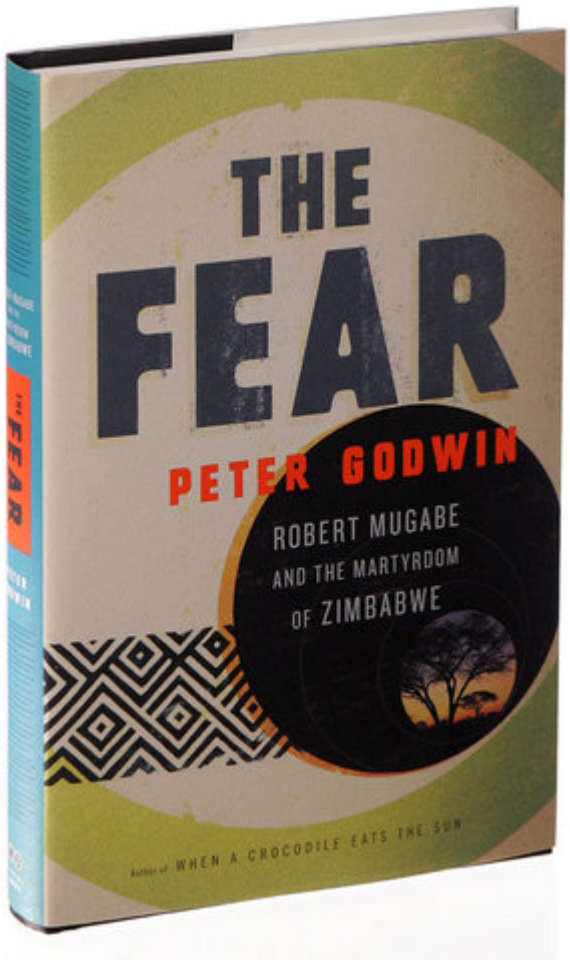
Mr. Brown puts it this way: “Feminists should be consistent on the subject of choice. If a woman has the right to choose to have an abortion, she should also have the right to choose to have sex for money. It’s her body, it’s her right.”

“Paying for It,” which includes an introduction from another randy cartoonist, R. Crumb, is a thrumming human document, hardly a dissertation. It includes a precoital moment with one sex worker, Anne, who says to the author, when she learns he is a cartoonist, “I used to like Archie comics.”

Mr. Brown responds by saying, “My stuff’s quite different from Archie.” Truer words I have not recently read.

http://www.nytimes.com/2011/05/25/books/paying-for-it-is-chester-browns-memoir-of-prostitutes.html?ref=books

Where Dissidents Are the Prey, and Horror Is a Weapon
By MICHIKO KAKUTANI



THE FEAR

Robert Mugabe and the Martyrdom of Zimbabwe

By Peter Godwin

371 pages. Little, Brown & Company. $26.99.

An authoritarian government willing to use the most brutal means to hold on to power; a dictator whose thugs have murdered, tortured, imprisoned or intimidated tens of thousands of civilians; and individuals who have risked their lives simply to exercise their most fundamental rights — this is the state of affairs not only in Libya today, but also in Zimbabwe, which has suffered the ravages of more than 30 years under the autocratic rule of President Robert Mugabe.

In his chilling new book, “The Fear,” the journalist Peter Godwin gives readers an unsparing account of the horrors that Mr. Mugabe’s regime has inflicted on the people of Zimbabwe. During his three decades in office

the country's economy has tanked: agricultural production has plummeted, unemployment and food shortages have multiplied, inflation has soared, and much of the country's middle class has fled. AIDS cases have exploded, and medicine and medical help are in increasingly short supply.

Hopes that Mr. Mugabe's days as president might actually be numbered were dashed in the weeks leading up to a runoff election in June 2008, when supporters of the opposition leader Morgan Tsvangirai of the Movement for Democratic Change came under violent attack, and Mr. Tsvangirai announced his withdrawal as a presidential candidate, saying he could not ask people to come out to vote for him "when that vote would cost them their lives."

A so-called power-sharing government has been in place since 2008, but Mr. Mugabe has remained firmly in control; more than a quarter of his opponents in Parliament have been arrested, according to the Movement for Democratic Change and human-rights lawyers. Despite rumors about his health, Mr. Mugabe declared last week that he intended to run for president this year at the age of 87, and political violence is reportedly already increasing.

In "The Fear" Mr. Godwin chronicles the savagery of Mr. Mugabe's regime in harrowing detail. Some observers, he notes, call what has happened in Zimbabwe "politicide": "As genocide is an attempt to wipe out an ethnic group, so politicide is the practice of wiping out an entire political movement."

The murders carried out by the president's supporters and riot police around the time of the 2008 election, Mr. Godwin says, were "accompanied by torture and rape on an industrial scale, committed on a catch-and-release basis": "When those who survive, terribly injured, limp home, or are carried or pushed in wheelbarrows, or on the backs of pickup trucks, they act like human billboards, advertising the appalling consequences of opposition to the tyranny, bearing their gruesome political stigmata. And in their home communities, their return causes ripples of anxiety to spread." The people have given this time of violence and suffering its own name, chidudu — meaning "the fear."

In reporting this book Mr. Godwin traveled back to the country where he grew up, despite the dangers: "not only from Mugabe's banning of Western journalists, but also because I was once declared an enemy of the state, accused of spying." He uses his intimate knowledge of Zimbabwe to introduce readers to opposition leaders, church authorities, foreign diplomats and ordinary people who have ended up in hospitals or as refugees — beaten, mutilated, raped and terrorized, their houses burned to the ground.

This volume lacks the intimacy of the author's two affecting memoirs about Zimbabwe ("Mukiwa: A White Boy in Africa" and "When a Crocodile Eats the Sun"), and it sometimes assumes a little too much familiarity on the part of the lay reader with that country's tragic history. But it remains a document that should be read by anyone interested in the sacrifices that people are willing to make for the sake of democracy — a timely document, indeed, given the democratic uprisings taking place this spring in northern Africa and the Middle East. Not only is "The Fear" a valuable work of testimony — filled with firsthand accounts of witnesses to the most horrific crimes — but it is also a haunting testament to those survivors' courage and determination.

Among the ordinary citizens depicted in these pages is Tichanzii Gandanga, who worked for the Movement for Democratic Change. Mr. Godwin reports that Mr. Gandanga was kidnapped by thugs he believes were members of President Mugabe's spying agency, lashed with whips made from tire rubber and kicked in the face. His tormentors then dragged him naked into the road and ran over his legs twice with their car.

Denias Dombo, a farmer who also worked as a district organizing secretary for the movement, Mr. Godwin writes, watched as Mugabe supporters burned down his house, and he was then assaulted with rocks, iron bars and heavy sticks. According to Mr. Godwin, one leg was broken, an arm was shattered and several ribs fractured. His means of making a living, his plow and cultivator, were stolen; his cattle killed. He was unable to find his wife and children.

Dadirai Chipiro, a former nursery school teacher and the wife of an electoral organizer for the Movement for Democratic Change, did not survive an attack by government agents. They hacked off her right hand and both her feet, Mr. Godwin says, dragged her back into her house and set it on fire with a gasoline bomb.

The litany of suffering in this book is devastating, and the accounts that Mr. Godwin has collected, as the saying goes in Zimbabwe, are "just the ears of the hippo." There are many more stories and much more pain right below the surface. Thousands of people, he says, have simply gone missing: "Bodies are being found bobbing at the spillway of dams; other are discovered in the bush, dumped by their murderers, miles and miles from where they were abducted. In some particularly gruesome cases, the victims have been castrated, their testicles stuffed in their mouths, or their eyes gouged out. Many will never be found. Some 10,000 people have been tortured. Twenty thousand have had their houses burned down — up to 200,000 are now displaced."

As for prison conditions in the country, Mr. Godwin contends, they are miserable — another index "by which to measure the depths of depravity of Robert Mugabe's Zimbabwe." A freelance saw miller named Shane Kidd, who was thrown in prison after renting a room to the Movement for Democratic Change to use as an office, recounts in these pages how policemen would spray freezing water and sometimes throw buckets of urine through the prison bars, dousing the prisoners and their thin blankets and leaving the cell floors ankle-deep in water.

The opposition leader Roy Bennett reports that in Mutare Remand Prison rations had been cut to one meal from three, and that many inmates suffer from pellagra, a severe vitamin deficiency that was common in Soviet labor camps. Without outside food or medicine, Mr. Godwin writes, "the average inmate is dead within a year."

One of the most haunting stories in this volume is that of Chenjerai Mangezo, who was nearly beaten to death after winning as a movement candidate for a rural district council. Though his body was completely immobilized in plaster, Mr. Godwin says, Mr. Mangezo insisted on attending the swearing-in ceremony, and he was driven there lying on foam mattresses heaped in the back of a pickup truck. He has continued to attend council meetings, sitting alongside some of the very Mugabe supporters who oversaw his beating.

What, besides courage, has enabled Mr. Mangezo to sit there with his persecutors? "Is it fatalism, a quality that Westerners see in Africans?" Mr. Godwin asks. "Westerners often mistake African endurance, and the lack of self-pity, for fatalism. No, I think the other quality in Chenjerai Mangezo is patience, a dogged tenacity. He hasn't given up on getting justice. But he will wait for it."

"People like Chenjerai," he goes on, "are the real asine mabvi — the men without knees. Not only were his legs covered by plaster casts for months, but he has refused to kneel, refused to prostrate himself before the dictatorship, whatever the consequences."

http://www.nytimes.com/2011/05/24/books/the-fear-robert-mugabe-and-the-martyrdom-of-zimbabwe-by-peter-godwin.html?ref=books

The Parisian Experience of American Pioneers

By JANET MASLIN

William B. McCullough

THE GREATER JOURNEY

Americans in Paris

By David McCullough

Illustrated. 558 pages. Simon & Schuster. $37.50.

"The Greater Journey" is an important-looking book by the august historian David McCullough, who has twice won the Pulitzer Prize (for "Truman" and "John Adams") and is a regular source of Father's Day gifts for distinction-loving dads. His latest lavishly produced volume has a handsome collection of color photographs, a stellar cast of historically important American characters and a long, impressive bibliography. What it does not have is a unifying premise.

The vague rationale for "The Greater Journey" is that, beginning in the 1830s, waves of young Americans who would become important in art, education, medicine, literature, music and technological innovation went to Paris. They sought the kind of broadening experiences that were not available to them at home.

Unlike the heroes of the American Revolution, whose experiences Mr. McCullough has already addressed so well, these travelers did not necessarily have diplomatic business in France. They had sights to see, minds to broaden, effusions to emit ("My mind was smitten with a feeling of sublimity almost too intense for mortality," gushed Emma Willard, who would eventually found her eponymous school in upstate New York) and journals to fill with ecstatic observations about the Louvre, the cuisine and the weather. In trying to establish this as a raison d'être for the book, Mr. McCullough writes that "not all pioneers went west." He provides a slogan worthy of a movie poster: "At home it was known as the Old World. To them it was all new."

But Mr. McCullough is hard-pressed to sustain the idea of a unified "them" at the heart of his book. So he is forced to make awkward juxtapositions and segues among people who did not cross the Atlantic at the same time (though "everyone knew the perils of the sea"), did not live a shared narrative and did not share all that much common ground. He ends up delivering the kinds of space-filling observations that might not even pass muster in a high-school history paper. This is not the side of Mr. McCullough that has made him a national treasure.

"They were in Paris!" he writes. "It was no longer something to read about at home, or talk about at sea. They were there — this was nearly always the first thought on awakening each morning." That passage sleepwalks along until it builds up to a quotation from Balzac, who has nothing to do with this book. Later on, generalizing about the many artists who pass through a book that spans 70 years, he offers this: "Though no exact count was made of the American art students in Paris at the time, they undoubtedly numbered more than a thousand. And nearly all, judging by what they wrote then and later, were thrilled at the chance to be in Paris and found themselves working harder than they ever had."

The better parts of "The Greater Journey" are those that offer profiles, however sketchy, of specific people and should not have forced Mr. McCullough to make acrobatic connections, even though he does that with Samuel Morse and James Fenimore Cooper, who were demonstratively close friends. These two, he says, "had much in common" even though "much differed between Cooper and Morse." And "the bond of friendship between Cooper and Morse held fast through the long ordeal of the cholera epidemic" beginning in 1831; surely a terrible time, but also an epidemic in which no Americans visiting Paris were killed.

Mr. McCullough's account of how Morse, who would become best known for his telegraph and code, painted his monumental "Gallery of the Louvre" (1831-33) is absolutely worth the full chapter that it occupies in "The Greater Journey." So do the experiences of American medical students in Paris, whose educational opportunities (including free lectures at the Sorbonne) were vastly greater than anything available to them at home. In America, male doctors could not examine female patients; in France, they could learn about obstetrics. And Paris enabled Elizabeth Blackwell to go home and become the first female doctor in the United States.

But this book's single best research discovery is the diary kept by Elihu Washburne, the American ambassador to France during tumultuous times that extended through the end of the Franco-Prussian War and the destruction of the Paris Commune. (Some of Washburne's journal was reissued in paperback last year and, on the abundant evidence of his writing in "The Greater Journey," is well worth exploration.) Washburne's unfiltered amazement of the way Paris became a battlefield in May 1871 accounts for some of the most memorable, visceral passages to be found here. "All the fighting in all the revolutions which have ever taken place in Paris has been mere child's play compared to what has taken place since Sunday and what is going on now," he wrote, with the Palace of the Tuileries in flames and even the Louvre in imminent danger.

A strong section in the later part of the book is devoted to John Singer Sargent, described in detail as he painted Madame Pierre Gautreau as "Madame X," though not in great personal detail otherwise. ("How strongly attracted Sargent was to the opposite sex, or to his own, was and would remain difficult to determine" is the kind of diplomatic tidbit to be found here.) Another late part of the book describes the more moody and depressive Augustus Saint-Gaudens, even if his wife Augusta (or Gussie), is one of the countless people who Mr. McCullough allows to describe Paris's weather. ("To the delight of everyone, the weather was suddenly like summer," Gussie wrote in March 1880.)

There is also an account of French outrage over the "useless and monstrous" curiosity under construction in 1887: the Eiffel Tower. The tower's inclusion of an American-made Otis elevator is as good an explanation of its presence in this book as any.

"The Greater Journey" ends at the start of 1901, with Isadora Duncan and her family heading for France. "What the new century might hold for them and their generation, there was no telling," Mr. McCullough writes, hinting at what some future Father's Day may hold for us. "For now it was enough just being in Paris."

http://www.nytimes.com/2011/05/23/books/the-greater-journey-david-mcculloughs-latest-review.html?ref=books

Oh, the Stuff Those Lions Guard

By EDWARD ROTHSTEIN

Sara Krulwich/The New York Times

A Gutenberg bible on display as part of the New York Public Library's 100th anniversary exhibition

"One of the five greatest public libraries in the world" is the boast made at a new exhibition celebrating the centennial of the New York Public Library's august building on Fifth Avenue. And if we are inclined to question the claim, it is only because the institution's distinctiveness is scarcely suggested by putting it in a class with the Library of Congress, the British Library, the National Library of France and the Russian State Library.

As we learn in this show, "Celebrating 100 Years," the New York Public Library is the only one of this group that was not established by a national government. Unlike many Old World museums, it is also not an "imperial" institution, many of whose holdings were gathered through plunder and conquest. In addition, it was not established, as many such libraries were, to reflect the character of a nation; it was actually intended to help shape that country's character.

Moreover, that public mission gained its force from private visions. The Public Library was built on distinguished collections assembled by individuals of great wealth, discernment or passion. The Astor and Lenox libraries formed the core of this new library in 1895; artifacts gathered by Arthur Alfonso Schomburg in the 20th century's early decades form the core of the library's invaluable Schomburg Center for Research in Black Culture. And many of its other research collections have similar origins.

You can sample the results here. The show's curator, Thomas Mellins (who created a compelling exhibition about the history of Lincoln Center in 2009), has said that his primary goal was "to show the depth and breadth of the library's remarkable collections."

There are cuneiform tablets and typewriters, a Gutenberg Bible and 1960s political broadsheets; Kepler's diagram of the structure of the universe and women's dance cards from 19th-century balls; T. S. Eliot's

typescript of "The Wasteland" with emendations by Ezra Pound, and a Russian translation of Karl Marx's "Das Kapital." Also on view are the walking stick of Virginia Woolf's that her husband found floating in a river four days after she drowned herself and Beethoven's sketches as he worked on the Scherzo of the "Archduke" Trio.

But what ties the library's research collections together? And what themes does the exhibition itself reveal? That is less clear.

Some artifacts are of profound historical importance, like Thomas Jefferson's handwritten manuscript of "The Declaration of Independence." Others are of interest because of associations with recent political history, like a collection of condoms distributed by the Gay Men's Health Crisis in the 1990s.

Some are illuminating, like Charles Dickens's marked-up copy of "David Copperfield," in which he excised paragraphs and inscribed prompts that he used in public readings from the book. And his letter opener fully merits the adjective "Dickensian," with its quirky peculiarity and demonstrative eccentricity: the handle is made from the paw of Dickens's pet cat Bob, and the blade is engraved "C. D. In Memory of Bob 1862," the year of the cat's death.

But other objects make you wonder not just about the show's selections, but also about the library's curatorial strategies. Is Terry Southern's typewriter of collectible importance, given that his most celebrated credit may have been as a screenwriter for "Easy Rider" (1969)? Did curators at the Rare Book Division have anything in mind other than ironic mischief when they preserved a massage parlor handbill from the 1970s-era Times Square advertising "The Library" and promising "7 beautiful Librarians to service you"? The exhibition explains the handbill as part of the library's mission of acquiring ephemera, but collecting also makes an assertion that objects will have a future value. Is that the case here? Why?

The exhibition's own choices can also leave us confused. Two central display cases, for example, are used to emphasize the collection's variety with playful comparisons, noting that the library has items ranging "from art that changes how we see the world" (a 1936 Picasso etching of a turkey) "to art we see every day" (a swatch of cloth from Wesley Simpson Custom Fabrics); everything "from images that invite us to look" (a magazine about pornographic videos) "to images that cause us to look away" (an 1863 photograph of the dead lying on a Gettysburg battlefield).

The problem is that these comparisons put all objects on the same level. How important is that Picasso etching? What was special about that fabric company? As for the magazine's "Nasty XXX Pix!" and the bodies at Gettysburg, the juxtaposition inspires more queasiness than insight. As in other parts of the show, social, historical and aesthetic contexts dissolve, leaving many objects standing alone, as if each were a celebrity.

Ultimately, though, some objects here do take priority. The exhibition is divided into four themes: "Observation," "Contemplation," "Creativity" and "Society." Each is illustrated with featured central objects, while others appear in more crowded display cases. "Observation," for example, features Columbus and space exploration, while including Audubon, anatomy and cartography.

The themes, though, can be stretched to distraction. "Contemplation" includes some examples of religious devotion, but also artifacts only remotely associated with reflection, like a love letter from the poet John Keats. Extensive space in this section is also given to Malcolm X, who is represented by his briefcase, Koran and journal, which included an account of his hajj to Mecca; pages from that journal are also reproduced on a major wall panel. In the context of the exhibition, though, the attention seems disproportionate.

But if we are often not aware of the historical context of objects, or why they are displayed or collected, in the show's "Society" section that can be all we discern. We don't learn about the political philosophies and social organizations reflected in a millennium's worth of artifacts; we don't get a sense of the collection's range or

the subject's complexities. Instead, many objects seem selected because of their connections to more recent political preoccupations.

In the central section of "Society," for example, three historical documents are given pride of place: Jefferson's Declaration, George Washington's handwritten draft of his farewell address and a first edition of "The Star-Spangled Banner." But two other objects are given equivalent attention: a Ku Klux Klan robe and a 1960s-era pocket-size brochure from the Mattachine Society, one of the country's first organizations concerned with gay rights, called "What to Do if You're Arrested."

Of course, no history of American ideas can omit an examination of the country's failures and shortcomings. And here these two items clearly act to chastise and undercut the prestige of the historical documents. But in what way? What argument is being made? How sweeping are its assertions? The juxtapositions are pointedly imposed while being left unexamined.

Many objects in this section are selected to highlight themes raised by political movements of the 1960s, the decade that has the weightiest representation in the show. Items from the Schomburg collection are used to illustrate fragments of the civil rights battles. A display case about gay rights and culture contains a copy of Oscar Wilde's "Ballad of Reading Gaol," along with one of Robert Giard's photos of gay and lesbian writers, "Tony Kushner With Karl Marx Pillows." Another case is labeled "Changing Roles of Women."

The politics of rights and liberation could be explored in a separate exhibition using the library's collections; it might outline contexts, show a range of documentary materials, demonstrate the evolution of political movements and explore centuries of debates and transformations. Here, though, we are being telegraphed messages out of character with the rest of the show.

Of course, other approaches could have been taken to the entire exhibition. In 1985, for example, a show of library treasures organized artifacts into miniature thematic subjects, like "Bibles of All Cultures," "Settlement of the Americas," "Aesop and the Illuminated Book," "Hamlets on the New York Stage," "The Slavonic Worlds." That format created a context for objects while revealing something about the collection's range and importance. (And perhaps, with such a format, a section on political movements might have worked better.)

It is possible too that there has been a subtle shift in the library's own sensibilities, placing increased emphasis on relevance and popular appeal. If so, it may be worth recalling the institution's founding ambitions. In the gallery showing the history of the library, we can read part of a 1944 librarian exam.

"In selecting stories to tell to children with a foreign inheritance," one question asks, "what book would you choose for children from a. Denmark, b. Turkey, c. Brazil, d. Italy, e. Czechoslovakia." The question assumes that the library will welcome immigrants by first speaking directly to them, but it will then go further, inducting visitors into a wider, shared world. "What elements characterize the best writing for children?" librarians are asked. "Give examples."

Traditionally, the library was democratic without being populist. It collected artifacts and manuscripts because of their importance and because of where they could lead the public as well as scholars. The library served generations as an incubator for cultural and intellectual aspirations. And while there are many astonishing objects on display here that reflect that ambition, the exhibition seems to suggest that it may no longer be as powerful as it once was. Celebrations are being directed elsewhere.

"Celebrating 100 Years" is on view through Dec. 31 at the New York Public Library; nypl.org.
http://www.nytimes.com/2011/05/18/arts/celebrating-100-years-at-the-new-york-public-library-review.html?ref=books

Lingodroid Robots Invent Their Own Spoken Language

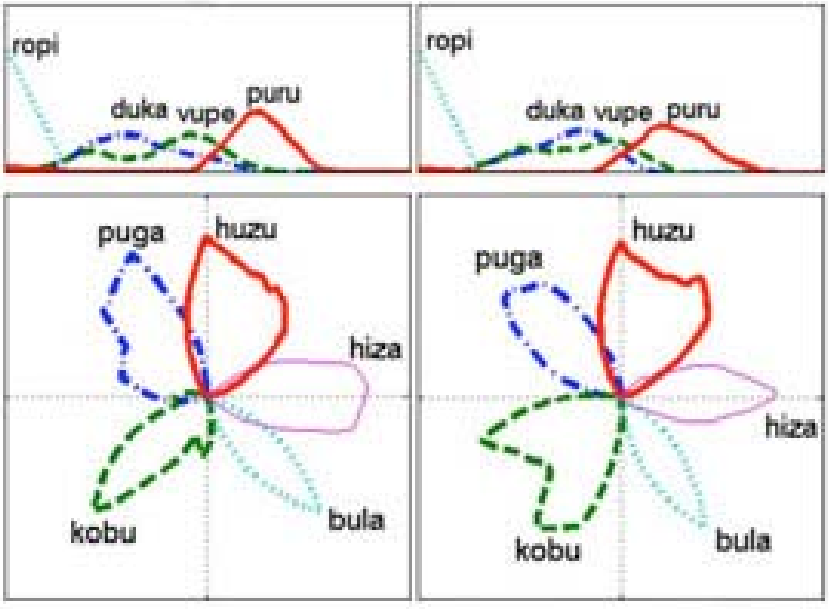
A pair of robots has made up their own words to tell each other where they are and where they want to go.

Mon May 23, 2011 11:15 AM ET

Content provided by Evan Ackerman, IEEE Spectrum

THE GIST

- Mobile robots each equipped with a microphone and speaker have developed a spoken language in order to communicate.
- The robots use the made-up words to describe location and distance.



The robots agreed on certain words for direction and distance concepts. For example, “vupe hiza” would mean a medium long distance to the east.

Ruth Schulz, University of Queensland

When robots talk to each other, they're not generally using language as we think of it, with words to communicate both concrete and abstract concepts. Now Australian researchers are teaching a pair of robots to communicate linguistically like humans by inventing new spoken words, a lexicon that the roboticists can teach to other robots to generate an entirely new language.

Ruth Schulz and her colleagues at the University of Queensland and Queensland University of Technology call their robots the Lingodroids. The robots consist of a mobile platform equipped with a camera, laser range finder and sonar for mapping and obstacle avoidance. The robots also carry a microphone and speakers for audible communication between them.

To understand the concept behind the project, consider a simplified case of how language might have developed. Let's say that all of a sudden you wake up somewhere with your memory completely wiped, not knowing English, Klingon or any other language. And then you meet some other person who's in the exact same situation as you. What do you do?

What might very well end up happening is that you invent some random word to describe where you are right now, and then point at the ground and tell the word to the other person, establishing a connection between this new word and a place. And this is exactly what the Lingodroids do. If one of the robots finds itself in an unfamiliar area, it'll make up a word to describe it, choosing a random combination from a set of syllables. It then communicates that word to other robots that it meets, thereby defining the name of a place.

From this fundamental base, the robots can play games with each other to reinforce the language. For example, one robot might tell the other robot “kuzo,” and then both robots will race to where they think “kuzo” is. When they meet at or close to the same place, that reinforces the connection between a word and a location. And from “kuzo,” one robot can ask the other about the place they just came from, resulting in words for more abstract concepts like direction and distance.

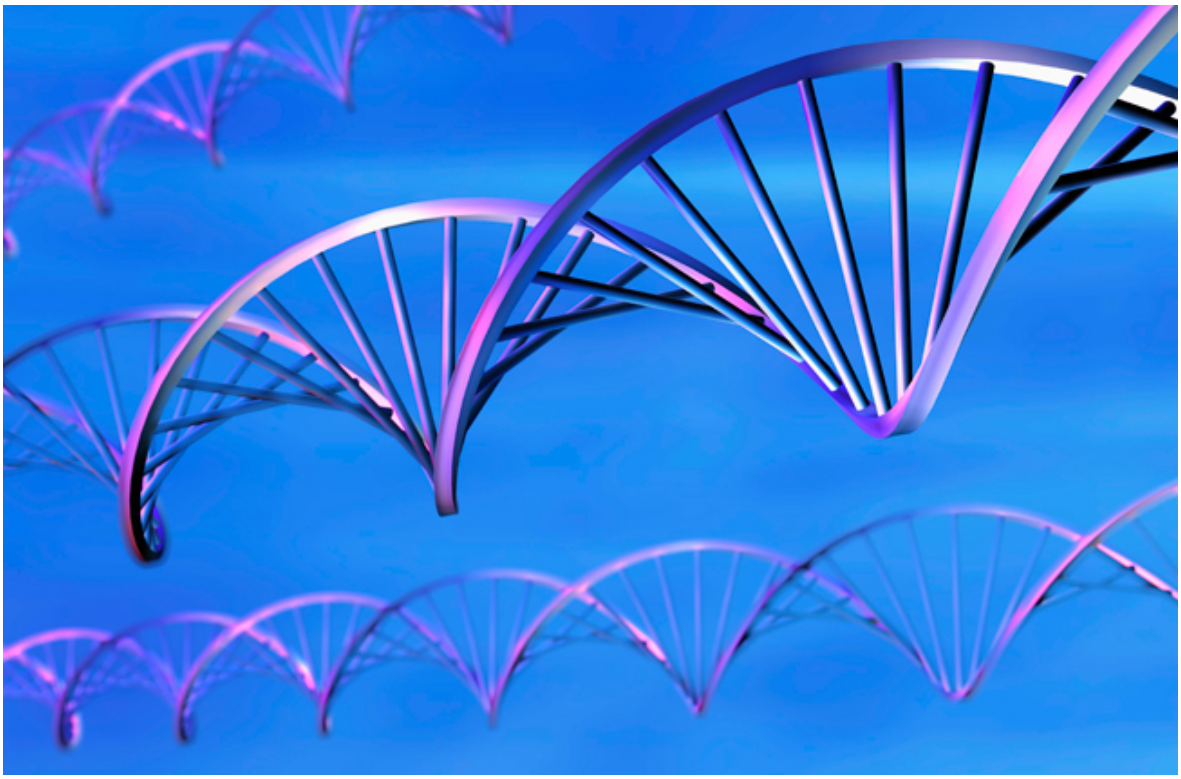
After playing several hundred games to develop their language, the robots agreed on directions within 10 degrees and distances within 0.375 meters. And using just their invented language, the robots created spatial maps (including areas that they were unable to explore) that agree remarkably well:

In the future, researchers hope to enable the Lingodroids to "talk" about even more elaborate concepts, like descriptions of how to get to a place or the accessibility of places on the map. Ultimately, techniques like this may help robots to communicate with each other more effectively, and may even enable novel ways for robots to talk to humans.

Schulz and her colleagues -- Arren Glover, Michael J. Milford, Gordon Wyeth, and Janet Wiles -- describe their work in a paper, "Lingodroids: Studies in Spatial Cognition and Language," presented last week at the IEEE International Conference on Robotics and Automation (ICRA), in Shanghai.

http://news.discovery.com/tech/robots-invent-their-own-spoken-language-110523.html#mkcpgn=rssnws1

Future Computers May Be DNA-Based
Analysis by Nic Halverson
Sat May 21, 2011 08:21 AM ET



We've all heard our brain likened to a computer. But professor Jian-Jun Shu and his students at Nanyang Technical University are taking that comparison quite literally.

Shu and his team at the university's School of Mechanical and Aerospace Engineering have proposed a way to use DNA strands for computing operations.

Their article "DNA-Based Computing of Strategic Assignment Problems," was recently published in the journal *Physical Review Letters*.

Shu points out that the human body performs computations that are naturally more faster than even the fastest silicon-based computer.

"No matter how fast tomorrow's conventional silicon-based computer can become," their article states,"in order to solve specific classes of problems, it may take the fastest silicon-based computer months or even years to process the calculations. This is mainly due to the serial computing nature of the conventional silicon-based computer."

So Shu and his students manipulated stands of DNA at the test-tube level. They found that they could fuse strands together, cut them and perform operations that would affect DNA's ability to store information.

"Silicon-based computing relies on a binary system," Shu told PhysOrg.com. "With DNA-based computing, you can do more than have ones and zeroes. DNA is made up of A, G, C, T, which gives it more range. DNA-based computing has the potential to deal with fuzzy data, going beyond digital data."

Shu says that DNA-based computing is currently in the most elementary stages and that more human manipulations must be done.

Credit: E.M. Pasieka/Science Photo Library/Corbis

http://news.discovery.com/tech/future-computers-may-be-dna-based-110521.html#mkcpgn=rssnws1

The MIT factor: celebrating 150 years of maverick genius

The Massachusetts Institute of Technology has led the world into the future for 150 years with scientific innovations. Its brainwaves keep the US a superpower. But what makes the university such a fertile ground for brilliant ideas?

- Ed Pilkington
- The Guardian, Wednesday 18 May 2011

MIT students at a physics class take measurements in 1957. Photograph: Andreas Feininger/Time & Life Pictures

Yo-Yo Ma's cello may not be the obvious starting point for a journey into one of the world's great universities. But, as you quickly realise when you step inside the campus of the Massachusetts Institute of Technology (MIT), there's precious little about the place that is obvious.

The cello is resting in a corner of MIT's celebrated media lab, a hub of techy creativity. There's a British red telephone kiosk standing in the middle of one of its laboratories, while another room is signposted: "Lego learning lab - Lifelong kindergarten."

The cello is part of the Opera of the Future lab run by the infectiously energetic Tod Machover. A renaissance man for the 21st – or perhaps 22nd – century, Machover is a composer, inventor and teacher rolled into one. He sweeps into the office 10 minutes late, which is odd because his watch is permanently set 20 minutes ahead in a patently vain effort to be punctual. Then, with the urgency of the White Rabbit, he rushes me across the room to show me the cello. It looks like any other electric classical instrument, with a solid wood body and jack socket. But it is much more. Machover calls it a "hyperinstrument", a sort of thinking machine that allows Ma and his cello to interact with one another and make music together.

"The aim is to build an instrument worthy of a great musician like Yo-Yo Ma that can understand what he is trying to do and respond to it," Machover says. The cello has numerous sensors across its body, fret and along the bow. By measuring the pressure, speed and angle of the virtuoso's performance it can interpret his mood

and engage with it, producing extraordinary new sounds. The virtuoso cellist frequently performs on the instrument as he tours around the world.

When Machover was developing the instrument, he found that the sound it made was distorted by Ma's hand as it absorbed electric current flowing from the bow. Machover had a eureka moment. What if you reversed that? What if you channelled the electricity flowing from the performer's body and turned it into music?

Armed with that new idea, Machover designed an interactive system for Prince that the rock star deployed on stage at Wembley Stadium a few years ago, conjuring up haunting sounds through touch and gesture. Later, two of Machover's students at the media lab had the idea of devising an interactive game out of the technology. They went on to set up a company called Harmonix, based just down the road from MIT in Cambridge, Massachusetts, from which they developed Rock Band and Guitar Hero.

From Ma's cello, via Prince, to one of the most popular video games ever invented. And all stemming from Machover's passion for pushing at the boundaries of the existing world to extend and unleash human potential. That's not a bad description of MIT as a whole. This maverick community, on the other side of the Charles River from Boston, brings highly gifted, highly motivated individuals together from a vast range of disciplines but united by a common desire: to leap into the dark and reach for the unknown.

The result of that single unifying ambition is visible all around us. For the past 150 years, MIT has been leading us into the future. The discoveries of its teachers and students have become the warp and weft of modernity, the stuff of daily life that we now all take for granted. The telephone, electromagnets, radars, high-speed photography, office photocopiers, cancer treatments, pocket calculators, computers, the internet, the decoding of the human genome, lasers, space travel . . . the list of innovations that involved essential contributions from MIT and its faculty goes on and on.

And with that drive into modernity MIT has played no small part in building western, and particularly US, global dominance. Its explosive innovations have helped to secure America's military and cultural supremacy, and with it the country's status as the world's sole superpower.

A typical MIT student 'hack' or prank: a replica Apollo lunar module on top of the university's famous dome. Photograph: Erik Nygren

As the school marks its 150th anniversary this month, it seems the US has never needed MIT's help more than it does today. The voices of the nay-sayers are in the ascendancy, questioning the US's ability to reinvent itself, to heal its wounded economy and sustain its leadership in the face of a burgeoning China. Questions too, are increasingly being asked about the ability of science and technology to address the world's problems, as optimism about the future slides into doubt. "There is a profound cynicism around the role of science that is debilitating for those in the enterprise, and devastating for this country," says MIT's president, Susan Hockfield. "If we can't figure out how to make technological innovation the path to the future, then America is not going to have invented the future, some other country will have."

She fears the US is increasingly suffering from what she calls a deficit of ambition. While 85% of MIT students are studying science and engineering, in the US as a whole the proportion is just 15%. That leaves the world's creative powerhouse vulnerable. "If you travel to Asia, to Shanghai or Bangalore, you feel the pulse of people racing to a future they are going to invent. You feel that rarely any more in the US."

Which makes MIT's mission all the more essential. "MIT has an enormous responsibility right now," Hockfield says. "We feel that deeply. It needs to be a beacon of inspiration around the power of science and technology to create a brighter future for the world."

No pressure, then.

From the moment MIT was founded by William Barton Rogers in 1861 it was clear what it was not. It was not like the other school up the river. While Harvard stuck to the English model of an Oxbridge classical education, with its emphasis on Latin and Greek as befitted the landed aristocracy, MIT would look to the German system of learning based on research and hands-on experimentation, championing meritocracy and industry where Harvard preferred the privileges of birth. Knowledge was at a premium, yes, but it had to be useful.

This gritty, down-to-earth quality, in keeping with the industrialisation that was spreading through the US at the time, was enshrined in the school motto, *Mens et Manus* – Mind and Hand – as well as its logo, which showed a gowned scholar standing beside an ironmonger bearing a hammer and anvil. That symbiosis of intellect and craftsmanship still suffuses the institute's classrooms, where students are not so much taught as engaged and inspired. There is a famous film of one of MIT's star professors, the physicist Walter Lewin, demonstrating the relationship between an oscillating metal ball and mass. Halfway through the experiment he climbs on to the ball and starts swinging himself around the lecture theatre in a huge oscillating arch as though he were appearing in Spider-Man on Broadway.

When Emily Dunne, an 18-year-old mechanical engineering student from Bermuda, was taking a course in differential equations recently, she was startled when her professor started singing in the middle of the lecture. "He was trying to show us how to understand overtones. It was kind of weird, but then everyone here is a little quirky," she says.

Mind and Hand applies too to MIT's belief that theory and practice go together; neither is superior to the other, and the two are stronger when combined. That conviction is as strongly held by the lowliest student as it is by its Nobel laureates (there have been 50 of them).

Take Christopher Merrill, 21, a third-year undergraduate in computer science. He is spending most of his time on a competition set in his robotics class. The contest is to see which student can most effectively programme a robot to build a house out of blocks in under 10 minutes. Merrill says he could have gone for the easiest route – designing a simple robot that would build the house quickly. But he wanted to try to master an area of robotics that remains unconquered – adaptability, the ability of the robot to rethink its plans as the environment around it changes, as would a human. "I like to take on things that have never been done before

rather than to work in an iterative way just making small steps forward," he explains. "It's much more exciting to go out into the unknown."

Merrill is already planning the start-up he wants to set up when he graduates in a year's time. He has an idea for a new type of contact lens that would augment reality by allowing consumers to see additional visual information. He is fearful that he might be just too late in taking his concept to market, as he has heard that a Silicon Valley firm is already developing similar technology. As such, he might become one of many MIT graduates who go on to form companies that fail.

Alternatively, he might become one of those who go on to succeed, in spectacular fashion. And there are many of them. A survey of living MIT alumni found that they have formed 25,800 companies, employing more than three million people including about a quarter of the workforce of Silicon Valley. Those firms between them generate global revenues of about $1.9tn (£1.2tn) a year. If MIT was a country, it would have the 11th highest GDP of any nation in the world.

Ed Roberts, MIT's professor of technological innovation and entrepreneurship, says such figures belie the fact that the institute is actually quite small, with just 10,000 students and about 1,000 faculty. "That's not big. But when all those people sign up to a mission to forward entrepreneurship, you have a dramatically bigger impact. In MIT, people are encouraged not just to think bold, but to do it boldly.

"If you come up with a brilliant idea, that's OK. If you win a Nobel prize for your research, that's fine. But if you take that idea and apply it and make something transformative happen, then in MIT that's deeply admired."

Inevitably, perhaps, there is a nerdy quality to the place that is reflected in one of its much cherished traditions – the student "hack". Hack is a misleading word here, as it is less to do with cracking into computers than with hi-tech high-jinks. "Prank" is a better description.

In the student canteen you can see two of the most famous MIT hacks preserved for prosperity – a police car that was balanced on top of the institute's great dome, and a functioning fire hydrant that was erected in one of the lobbies. The latter hack, dating from 1991, was a wry comment on a former president's remark that "getting an education from MIT is like taking a drink from a fire hose". Then there is the Baker House Piano Drop, an annual institution ever since students first dropped a stand-up piano from a sixth-storey dormitory in 1972, then measured the impact that it made when it crashed on the pavement below.

Wacky, perhaps. Geeky, certainly. But also extraordinarily difficult technically and requiring great imagination and ingenuity. MIT in a nutshell.

The current president offers two other important clues to MIT's success as a cauldron of innovation. The first is meritocracy. Hockfield is MIT's first female president, which is significant for an institution that since the 1990s has been battling against its own in-built discrimination against women. Women still make up only 21% of the faculty. But the gender balance of its students is almost 50:50, and about 40% of its staff members were born outside the US, underlying how MIT remains a huge magnet for talented individuals around the world. "It's one thing to talk about fostering creativity, but unless you strive for a true meritocracy you are driving away the best people, and what would be the point of that?" Hockfield says.

MIT delights in taking brilliant minds in vastly diverse disciplines and flinging them together. You can see that in its sparkling new David Koch Institute for Integrative Cancer Research, which brings scientists, engineers and clinicians under one roof. Or in its Energy Initiative, which acts as a bridge for MIT's combined firepower across all its five schools, channelling huge resources into the search for a solution to global warming. It works to improve the efficiency of existing energy sources, including nuclear power as it has its

own nuclear reactor, a lesser-known fact that MIT prefers not to brag about. It is also forging ahead with alternative energies from solar to wind and geothermal, and has recently developed the use of viruses to synthesise batteries that could prove crucial in the advancement of electric cars.

MIT linguistics professor Noam Chomsky in his office in the Stata Centre. Photograph: Rick Friedman/Corbis

Before my tour of MIT ends I am given a taste of what this astonishing abundance of riches means in practice. In the space of half an hour I enjoy the company – in the flesh and spacially – of three of the towering figures of the modern age.

I begin by dragging Tim Berners-Lee away from his computer screen to talk to me about how he ended up here. The Briton who invented the world wide web is part of the global brain drain to MIT. He created the web by linking hypertext with the internet in 1989 while he was at Cern in Geneva, but then felt he had no option but to cross the Atlantic. "There were a couple of reasons I had to come – one was because the web spread much faster in America than it did in Europe and the other was because there was no MIT over there."

What is it about MIT that Europe could not offer him?

"It's not just another university, it has this pre-eminent reputation and that in turn sets up a self-fulfilling prophecy: as soon as it becomes seen as the cool place to go for technology, then people will head there as I did. Even though I spend my time with my head buried in the details of web technology, or travelling the world, the nice thing is that when I do walk the corridors I bump into people who are working in other fields that are fascinating, and that keeps me intellectually alive."

Berners-Lee offers to take me to my next appointment, and in so doing makes his point about MIT's self-fulfilling prophecy even more eloquently. We walk along the squiggly corridors of MIT's Stata Centre, which was designed by Frank Gehry. It is a classic Gehry structure, formed from undulating polished steel and tumbling blocks of brushed aluminium that reminds Berners-Lee, he tells me, of the higgledy-piggledy Italian village one of his relatives grew up in. After negotiating a maze of passageways Berners-Lee delivers me at the door of Noam Chomsky. It sums up this wild place: the inventor of the web leads me through the work of a titan of modern architecture to one of the world's foremost linguists and anti-war activists.

Chomsky is in a hurry. On the night of our meeting he will appear on stage alongside the Kronos Quartet at the world premiere of a new piece of music dedicated to him. The composer? Tod Machover, he of the Yo-Yo Ma cello.

I put it to Chomsky that it's a revealing paradox that he, as a leading critic of the US's overweening military might, has been based, since the 1950s, at an institution that was centrally involved in erecting the burgeoning military-industrial complex he so incisively opposes. After all, MIT has long been a leader in military research and development, receiving huge sums in grants from the Pentagon. It was core to America's prosecution of the cold war, developing ever more sophisticated guidance systems for ballistic missiles trained on Moscow.

"What people don't understand is that the role of the Pentagon," Chomsky says, "to a large extent was developing the technology of the future. There were some odd things about it. This building was also one of the centres of the antiwar resistance, and it was right in there, 100% funded by the Pentagon. But they didn't care."

What does that tell us about MIT?

"I was just left alone to my own devices. Other people took days off to run their businesses; I went off as an antiwar activist. But no one ever objected. MIT is a very free and open place."

http://www.guardian.co.uk/education/2011/may/18/mit-massachusetts-150-years-genius

Paperwork Explosion

May 18, 2011
Ben Kafka
"The government's laws and orders will be transmitted to the furthest reaches of the social order with the speed of electric fluid."1 Such was the promise made by the chemist, industrialist, and minister of the interior Jean-Antoine Chaptal in 1800. It could be said to signal a shift in the West's way of thinking about official recordkeeping. The idea of the paperless office was born.

Media historians have long recognized the astounding versatility, portability, and durability of paper, which is in many respects the ideal material support. As a corollary, the paperless office has been dismissed as a "myth" by social scientists, information engineers, and corporate consultants alike, who predict that paper's many affordances will continue to make it indispensable.2 And a myth it is, but not (or at least not only) in the simple sense typically employed in these contexts. The paperless office should also be interpreted as a myth in the Lévi-Straussian sense of the term, that is to say, an imaginary resolution to real contradictions.

What contradictions? We get a preliminary idea by examining a remarkable little film, *The Paperwork Explosion* (1967). Commissioned by IBM, the film was directed by a little-known experimental filmmaker named Jim Henson and scored by the Raymond Scott, the composer and inventor who wrote most of the tunes behind Looney Tunes, introduced the first racially integrated network studio orchestra, and pioneered electronic music with such technologies as the Orchestra Machine, the Clavivox, and the Electronium. Henson and Scott's collaboration explains, no doubt, the film's considerable formal intelligence and diegetic wit.3

The film promotes the IBM MT/ST, a machine released in 1964 combining the company's Selectric typewriter with a magnetic tape disk. Operators entered text and formatting codes onto magnetic tape; they could then make simple changes before printing a clean copy of the document. More advanced versions of the machine included two tape drives, allowing for mail merge and similar features. Among historians of computing, the MT/ST is best known as the first machine to be marketed as a "word processor" (a term that, as Thomas Haigh has pointed out, emerged at the same moment as Cuisinart's "food processor").4

The IBM film opens with an extraordinary montage of the history of media and communication: scribes and printing presses, watermills and assembly lines, container ships and spacecraft. This montage is interrupted by the sound of brakes squealing and the image of a car swerving towards the viewer. Cut to a rural scene, the sound of chickens, an old man with a corncob pipe. "Well," he says. "You can't stop progress." A quick glimpse of a subway train before a man who looks like he must be an engineer of some kind tells us "It's not a question of stopping it so much as just keeping up with it." An image of a jetliner before another talking head — thick frames, thin tie — tells us that "At IBM our work is related to the paperwork explosion." Suddenly stacks of paper on a desk explode into the air and sail through a blue sky. Another voice tells us "specifically, paperwork in an office," while paperwork explodes in the figurative sense, spilling out of desks and drawers. Then a repeat of the literal explosion. "Paperwork explosion" a voice says.

We are not quite one minute into the five-minute film. Faces of office workers appear one after the other to tell us that "There's always been a lot of paperwork in an office — but today's there more than ever before — there's more than ever before — *certainly more than there used to be!"* This last statement is spoken by the old farmer, whose folksy observation also concludes the next montage: "In the past, there always seemed to be enough time and people to do the paperwork — there always seemed to be enough time to do the paperwork — there always seemed to be enough people to do the paperwork— there always seemed to be enough time and people to do the paperwork — *but today there isn't."* The pulse of Raymond Scott's electronic music accelerates as more faces speak to us of their struggles with paperwork: "Today everyone has to spend more time on paperwork: management has to spend more time on paperwork — secretaries have

to spend more time on paperwork — companies have to spend more time on paperwork — salesmen — brokers — engineers — accountants — lawyers — supervisors — doctors — executives — teachers — office managers — bankers — foremen — bookkeepers — everybody has to spend more time on paperwork." Once again we see a shot of paperwork exploding. The farmer: *"Seems to me we could use some help."*

The Paperwork Explosion takes its place in a long history of images of paperwork combusting.1. 800px-Turner-The_Burning_of_the_Houses_of_Lords_and_Commons.jpg This history might begin with J.M.W. Turner's two brilliant canvases *Burning of the Houses of Parliament* (1835). These fires weren't sparked by paperwork, exactly, but by the notched wood sticks used for some eight centuries by the Exchequeur's office to record receipts and expenditures. As Charles Dickens recounted twenty years later: "The sticks were housed in Westminster, and it would naturally occur to any intelligent person that nothing could be easier than to alllow them to be carried away for firewood by the miserable people who lived in that neighborhood. However, they never had been useful, and official routine required that they should never be, and so the order went out that they were to be privately and confidentially burned."5 The sticks were thus unceremoniously fed to a furnace in the basement of the House of Lords on October 16, 1834. They took their revenge, however, by taking the Houses of Lords and Commons with them into the flames. Turner's paintings depict the accident in delirious detail.6

Think also of the paperwork explosion that opens the narrative of Fassbinder's *The Marriage of Maria Braun* (1979). As the film opens, we hear bombs falling and watch a wall collapse to reveal a wedding in progress. The bride and groom and guests scramble to get out of the Civil Registry Office as women scream and babies cry and hundreds and hundreds of documents tumble through the air. "Sign here! Put a stamp on it!" Maria Braun yells to the Nazi official as they lie on the ground. The image reappears several years later in Terry Gilliam's *Brazil* (1985), as Robert De Niro's character vanishes beneath with paperwork falling from the sky following the destruction of the Ministry of Information.

"IBM can help you with the time it takes to do the paperwork," the film continues. We see sexy shots of machines as voices offscreen tell us that "With IBM dictation equipment I can get four times as much thinking recorded as I can by writing it down…" The voices continue to explain the various features and benefits of IBM office equipment: cordless dictation, error-free copy, improved typography, increased productivity. "IBM machines can do the work — so that people have time to think — machines should do the work — that's what they're best at — people should do the thinking — that's what they're best at." Once again the music accelerates as a series of faces and voices speed across the screen: "Machines should work — people should think — machines — should work — people — should think — machines — should — work — people — should — think."

* * *

The "paperwork explosion" expresses both a threat and a wish. The threat, of course, is that we are being overwhelmed by paperwork's proliferation, its explosion — a threat that historian Ann Blair has recently traced through the early modern period.7The *wish* is to convert all this cumbersome matter into liberating energy, which is exactly what explosions do. From Chaptal's "electric fluid" to IBM's "Machines Should Work, People Should Think" to USA.gov's "Government Made Easy," we remain attached to the idea that someday, somehow, we can liberate this energy, put it to other uses.

Significantly, in this film, the liberation of this energy ends up being the liberation of labor. This becomes apparent at the very end, when we discover that our farmer is not exactly a farmer after all, but has returned from the future to deliver his message. *"So I don't do too much work anymore,"* he tells us. *"I'm too busy thinking."* The camera fades to black as a harmonic plays gently in the background in striking contrast to electronic pulses and clattering machinery that have provided the soundtrack so far. In the future, machines work while people think. This is the old utopian dream of a government of men replaced by the administration

of things (or of bits of data). This is man who has been hunting in the morning, fishing in the afternoon, herding in the evening, philosophizing after dinner, surfing the web late into the night, without having become a hunter, fisherman, herdsman, philosopher, or coder. This is man unalienated. Not bad results from a business machine.

Yet we must not miss the ambiguity here. "Machines should work, people should think." The message repeats itself several times; it's the core of the film's techno-utopian vision. We can imagine IBM executives and lawyers and public relations agents sitting across a table from Jim Henson telling him to make sure he includes these lines in his film. What if, following William Empson's advice to readers of poetry, we shifted the emphasis just a little bit? From "*machines* should *work*, *people* should *think*" to "machines *should* work, people *should* think"? Is it possible that the film might be trying to warn us against its own techno-utopianism? Read this way, the film is less an imaginary resolution to the problem of information overload in the modern era than an imaginative critique of this imaginary resolution. Machines should work, but they frequently don't; people *should* think, but they seldom do.

Ben Kafka

Ben Kafka is an assistant professor of the history and theory of media at NYU. His first book, *The Demon of Writing: Powers and Failures of Paperwork*, will be published by Zone Books in fall 2012

- **1** *Archives Parlementaires*, 2eme série (Paris: Librairie administrative de P.Dupont, 1879-): I:230 (Session of 28 pluviôse an VIII). Go Back
- **2** The classic text is Abigail J. Sellen and Richard H.R. Harper, *The Myth of the Paperless Office* (Cambridge, MA: MIT Press, 2002). Go Back
- **3** I am aware of two slightly different versions of this film: one obtained from the IBM archives and another posted on YouTube by the Henson Company: http://www.youtube.com/watch?v=_IZw2CoYztk. The Henson version includes the opening montage; the IBM version doesn't. Go Back
- **4** Thomas Haigh, "Remembering the Office of the Future: The Origins of Word Processing and Office Automation," *IEEE Annals of the History of Computing* (October-December 2006); pp. 6-31. Go Back
- **5** Charles Dickens, "Administrative Reform: Theory Royal, Drury Lane, Wednesday, June 26, 1855," in *Speeches Literary and Social* (London: John Camden Hotten, 1870), 132–133. Go Back
- **6** For a marvelous investigation of this incident, see Edward Eigen, "On the Record: J.M.W. Turner's Studies for the Burning of the Houses of Parliament and Other Uncertain Bequests to History," *Grey Room* 31 (Spring 2008); pp. 68-89. Go Back
- **7** Ann M. Blair, *Too Much to Know: Managing Scholarly Information before the Modern Age* (New Haven: Yale University Press, 2010). Go Back

http://www.west86th.bgc.bard.edu/articles/paperwork-explosion.html#

Milky Way faces midlife crisis

- 13:41 20 May 2011 by **David Shiga**

Our home galaxy is in the midst of a mid-life crisis, with the bulk of its star-formation behind it, a new study suggests. An impending merger with another galaxy will provide only a brief flurry of activity in an otherwise dull future.

Most galaxies fall into one of two camps: blue galaxies that form stars vigorously and are full of young, blue stars, and red galaxies that produce stars sluggishly or not at all and are dominated by older, red stars.

Galaxies of intermediate colour, called "green valley" galaxies, are relatively rare. They are thought to be in the process of changing from blue to red, with star-formation waning.

A new study by Simon Mutch of the Swinburne University of Technology in Hawthorn, Victoria, Australia, and colleagues suggests our own galaxy is experiencing such a decline. It appears to have entered the green valley, with a future as a red, dead galaxy looming on the horizon.

Blind spots

The Milky Way's overall colour is difficult to determine from our position inside it, as dust clouds create "blind spots" that block visible light from many of its regions. However, infrared observations, which can penetrate dust, have revealed that its star formation rate is unexceptional, too low to put it clearly in the blue group and too high to be unequivocally red.

To figure out what stage of life our galaxy is in, Mutch's team simulated the formation and evolution of 25 million galaxies and selected those similar to the Milky Way in terms of their star formation rate, shape and the total mass of their stars.

The researchers found that these simulated Milky Ways were mostly green valley galaxies, suggesting that the real Milky Way is in this transitional state too, the team reports in a paper to appear in the *Astrophysical Journal*.

Not over yet

Past outbursts from the massive black hole at the Milky Way's centre may be to blame for this mid-life crisis. Radiation "burps" produced after matter fell into the black hole could have heated and expelled gas from the galaxy, the team says.

So when will the Milky Way put its star-forming years behind it? If it behaves like the galaxies in the simulation, it will spend just 1.5 billion years in the green valley before going red.

But Rosemary Wyse of Johns Hopkins University in Baltimore, Maryland, says this mid-life period could be extended in the real Milky Way. Some gas clouds – which could go on to form stars – appear to be falling onto the galaxy. Still, she says: "Star formation probably will decrease with time."

Joint retirement

And there may be a brief burst of star formation in 5 billion years, when the Milky Way is expected to merge with Andromeda, a nearby spiral galaxy whose properties also indicate it is a green valley galaxy, the team says.

The merger may send residual gas towards the centre of the merged object, triggering a short stellar baby boom before the galaxy settles into old age, says team member Darren Croton, also at Swinburne. The spiral discs of both galaxies will be destroyed in the collision, he says: "The violence of the merger will cement our place as a red and dead elliptical galaxy."

In case this sounds depressing, he notes that red elliptical galaxies are not completely devoid of activity. "Many of them continue to lead very interesting lives in their retirement," he says, pointing to a nearby elliptical called M87 that has spectacular jets streaming from its central black hole.

http://www.newscientist.com/article/dn20497-milky-way-faces-midlife-crisis.html

Solar system's big bully leaves others looking flat

- 15:33 25 May 2011 by **Jeff Hecht**

Exoplanet systems around other stars are surprisingly flat compared with our own. The discovery means that the solar system must have had a far more colourful history than many of its counterparts and is forcing astronomers to rethink their ideas about the way planetary systems form.

The new findings come from NASA's Kepler spacecraft, which has spent the past two years looking for the telltale dimming of nearby stars as planets pass in front of them. So far it has looked at 155,000 stars and found 1000 with signs of planets.

That doesn't mean planets are rare – far from it. Kepler can only spot a planet if its orbital plane is in line with the spacecraft's view of the star. For Kepler to see two or more planets in a system, their orbits must be aligned to within about 1 degree of each other. "They have to be flatter than the solar system, which has orbits tilted by up to 7 degrees," David Latham of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Massachusetts, told *New Scientist* at a meeting of the American Astronomical Society on Monday.

Because of this, Latham expected Kepler to find only a handful of multiplanet systems. But to his surprise, the telescope has spotted 170 systems with more than one planet. These systems all have one thing in common: Kepler has seen little evidence of Jupiter-like gas giants in them.

Level-tempered

In our solar system, Jupiter is a gravitational bully that kicks smaller planets as they pass by. That's why the planets here are out of alignment. The absence of a malign influence like this could be why other planetary systems appear to be much calmer and flatter.

For example, Kepler has seen six closely spaced planets orbiting in a flat plane in a system called Kepler 11 – and the largest is only about the size of Neptune. "This suggests that it is much easier to keep systems quiet if the planets are small," says Alessandro Morbidelli of the Observatory of Nice, France, who was not involved in the Kepler analysis.

The new finding is raising more questions than it answers about planetary systems, however. Kepler has found hundreds of stars with one exoplanet, but these may have other planets that are out of alignment. "We still don't know what a typical planetary system looks like," says Hal Levison of the Southwest Research Institute in San Antonio, Texas.

http://www.newscientist.com/article/dn20507-solar-systems-big-bully-leaves-others-looking-flat.html?full=true&print=true

Linguists break into Skype conversations

17:01 25 May 2011

Jacob Aron, technology reporter

VoIP: encrypted but vulnerable to linguistic attack (Image: Frederic Sierakowski/Rex Features)

Chatting over internet phone networks like Skype may not be as secure as once thought: security researchers have shown that encrypted voice-over-internet-protocal (VoIP) conversations can be partially understood by an eavesdropper.

Transmitting voice data through the internet securely involves encoding and then encrypting speech. This combination of two signal-processing techniques means the size of the encrypted data packets reflect properties of the original speech, a key vulnerability that allowed a team of computer scientists and linguists at the University of North Carolina at Chapel Hill to reconstruct words and phrases from a VoIP call.

The team listen in by splitting the sequence of encrypted VoIP data packets into sequences that correspond to phonemes, the short sounds that form the building blocks of speech. They then apply linguistic rules to turn a string of phonemes into words - for example, the spoken conjunction that sounds like "zzdr", which occurs in the middle of "eavesdrop" (say it out loud and you'll hear it) never appears at the start of an English word.

The researchers compare the technique to the way infants learn to understand speech, segmenting the stream of sound coming from an adult's mouth into words by using linguistic clues such as separating out their own name.

Users don't need to worry about people listening in on their entire Skype conversation though, as the success of their technique varies widely. The team tested it on 6300 recordings in eight American English dialects and evaluated the performance using METEOR, a widely used scoring system for comparing machine translation techniques. Only 2.3 per cent scored over 0.5, meaning they are generally considered understandable, though some scores were much higher with near-perfect recovery of full sentences.

Even though their success rate is low, the researchers told the IEEE Symposium on Security and Privacy in Oakland, California, this week that no information should be leaking out of a supposedly encrypted communication, and say that future advances in computational linguistics are likely to improve their reconstructions.

One fix might be to change the encoding and encryption schemes used in VoIP software, or to alter the transmission by dropping some packets or padding them with meaningless data - though this could affect call quality.

www.newscientist.com/.../words-leak-from-encrypted-onli.html

Robo-Jeeves finds and folds your crumpled shirts

- 24 May 2011 by **Paul Marks**
- Magazine issue 2813. Ç

A bit small for me... (Image: UC Berkley)

SIMPLE as they seem, many routine domestic chores are still a big problem for robots. Fetching a beer from the fridge may be within a robot's grasp, but ask it to clear up a messy bedroom and it will be stumped. To a robot, a crumpled pair of trousers can look much like a discarded T-shirt, and it will struggle to tell a fluffy slipper from a sleeping cat.

The International Conference on Robotics and Automation in Shanghai, China, last week heard how some of these problems are being tackled. Pieter Abbeel and colleagues at the University of California, Berkeley, for example, have devised software routines capable of recognising items of clothing even when they are "crudely spread out" on a flat surface such as a bed. The software runs on a commercial robot called PR2, made by Willow Garage in Menlo Park, California.

To identify a mystery garment, the robot first holds it up using one of its two grippers. This allows it to estimate the garment's length, by using its twin cameras to detect its lowest point. Next, the robot holds the garment with both grippers and records its outline as well as distinguishing features that may correspond to a collar or buttons.

The software then applies a statistical technique called principal component analysis (PCA) to generate a digital signature - a list of parameters that characterise an item according to whether it has sleeves or buttons, for example. By comparing this against a database of common clothes, the robot can decide what kind of garment it is holding.

Having made its decision, the robot then folds the item according to the appropriate entry in a stored table of instructions. In tests run by the researchers, the PCA-based technique proved around 90 per cent accurate at identifying garments.

At Cornell University in Ithaca, New York, a team led by Ashutosh Saxena has programmed a robot to find shoes scattered about the home. The software is primed with data on the form and other characteristics of shoes, and the team says it can be adapted to find other household objects.

One of the software's tricks is to pay special attention to places where shoes might be likely to end up: under a bed, beneath a coffee table or next to a kitchen cabinet, for example. The team has also developed software that allows robots to grasp household objects without damaging them.

In the same week as the Shanghai meeting, iRobot of Bedford, Massachusetts, the company which makes the Roomba robot vacuum cleaner, was drumming up support for its new domestic robot at a Google developer conference in San Francisco. Named Ava, the robot has an Android or iPad tablet as its "head", and the company is encouraging software developers to create new apps for it, much as they would for a smartphone.

Kerstin Dautenhahn, a roboticist at the University of Hertfordshire, UK, welcomes the fact that robots are moving beyond being able to simply dance or run, and are being programmed to perform what at first sight seem mundane tasks. "These 'little' tasks are in fact very valid challenges that are big problems for machines," she says. "It's time they were focused on."

http://www.newscientist.com/article/mg21028137.800-robojeeves-finds-and-folds-your-crumpled-shirts.html?full=true&print=true

Twitter forces rethink on English privacy law

- 17:03 23 May 2011 by **Jacob Aron**

Twitter is forcing the UK government to re-examine privacy laws in England.

The rethink comes after a judge granted a privacy injunction, meaning that English newspapers could not legally publish the name of a professional soccer player who allegedly had an affair, despite thousands of people who have reported the name on the social-networking site.

Prime Minister David Cameron has called the situation "unsustainable".

The footballer issued legal proceedings against Twitter and "persons unknown" – the tweeters who had repeated his name. But the action is unlikely to succeed, because English courts have no jurisdiction over the US-based company. "There are real challenges to bringing an action against Twitter," says Dominic Crossley, a partner at the London law firm Collyer Bristow who specialises in privacy law.

Although the player's name has also been published on blogs and Wikipedia, the ease and speed at which information spreads on Twitter makes it a significant threat to injunctions. Users can retweet other's messages to their followers with a single click, rapidly distributing them through the network.

Crossley says that retweeters are unlikely to face legal consequences, but the initial tweeter could: "There may have been a journalist who deliberately disseminated this and encouraged the enormous publication on Twitter. If that is the case, he or she could go to prison."

The clash between law and technology coincides with the publication last week of a judicial report on the use of injunctions and superinjunctions, in which the press cannot even report the existence of an injunction. The report was commissioned in April 2010 but makes no recommendation on enforcing injunctions on sites like Twitter. "I do think there is a need for this issue to be looked at," says Crossley.

This morning Cameron said, "I think the government and Parliament have got to take some time out, have a proper look at this, have a think about what we can do, but I'm not sure there is going to be a simple answer."

The footballer was later named in the House of Commons as Manchester United player Ryan Giggs. Member of Parliament John Hemming identified the player using parliamentary privilege.

http://www.newscientist.com/article/dn20501-twitter-forces-rethink-on-english-privacy-law.html

Gene for tooth enamel could prevent decay

- 13:03 20 May 2011 by **Wendy Zukerman**

Not a filling to be seen (Image: RunPhoto/Getty)

The tooth fairy could soon have less work on her hands now that a gene needed to make tooth enamel has been identified.

Humans cannot restore tooth enamel when it is damaged because the cells that produce it, called ameloblasts, retire once enamel fully covers mature teeth. Consequently, if the surface of our pearly whites becomes compromised through poor diet or inadequate tooth-brushing, cavities form as bacteria attack layers deeper down.

James O'Sullivan at the University of Manchester, UK, and colleagues, scanned the genomes of four people from the same family who shared a genetic disorder called amelogenesis imperfecta (AI) that leads to weak enamel, and five family members without the condition. They then compared the results with 952 DNA samples from unrelated individuals.

Family trait

Family members with AI had a mutation on both copies of the gene *FAM20A*. The four unaffected family members had only one copy of the mutated gene. None of the DNA samples from unrelated people had the mutation.

In mice, a normal version of *FAM20A* was expressed throughout the teeth, and at particularly high rates when ameleoblasts were maturing, adding weight to the idea that the gene plays a key role in the production of enamel.

Tony Phan, an oral biologist at the University of Western Australia in Crawley, suggests that the protein created by *FAM20A* may boost the production of enamel by binding to ameloblasts. If so, it may be possible to use the protein to reactivate the enamel-producing cells on damaged teeth to prevent decay taking hold, he says.

Journal reference: *The American Journal of Human Genetics*, DOI: 10.1016/j.ajhg.2011.04.005

http://www.newscientist.com/article/dn20496-gene-for-tooth-enamel-could-prevent-decay.html

Mind-reading scan identifies simple thoughts

- 17:56 26 May 2011 by **Andy Coghlan**

A new new brain imaging system that can identify a subject's simple thoughts may lead to clearer diagnoses for Alzheimer's disease or schizophrenia – as well as possibly paving the way for reading people's minds.

Michael Greicius at Stanford University in California and colleagues used functional magnetic resonance imaging (fMRI) to identify patterns of brain activity associated with different mental states.

He asked 14 volunteers to do one of four tasks: sing songs silently to themselves; recall the events of the day; count backwards in threes; or simply relax.

Participants were given a 10-minute period during which they had to do this. For the rest of that time they were free to think about whatever they liked. The participants' brains were scanned for the entire 10 minutes, and the patterns of connectivity associated with each task were teased out by computer algorithms that compared scans from several volunteers doing the same task.

This differs from previous experiments, in which the subjects were required to perform mental activities at specific times and the scans were then compared with brain activity when they were at rest. Greicius reasons his method encourages "natural" brain activity more like that which occurs in normal thought.

Read my mind

Once the algorithms had established the brain activity necessary for each task, Greicius asked 10 new volunteers to think in turn about each of the four tasks. Without knowing beforehand what each volunteer was thinking, the system successfully identified 85 per cent of the tasks they were engaged in. "Out of 40 scans of the new people, we could identify 34 mental states correctly," he says.

It also correctly concluded that subjects were not engaged in any of the four original activities when it analysed scans of people thinking about moving around their homes.

The findings suggest that patterns for thousands of mental states might serve as a reference bank against which people's thoughts could be compared, potentially revealing what someone is thinking or how they are feeling. "In some dystopian future, you might imagine reference patterns for 10,000 mental states, but that would be a woeful application of this technology," says Greicius.

The idea of the system being used by security services or the justice system to interrogate prisoners or suspects is far-fetched, Greicius says. Thousands of reference patterns would be needed, he points out, and even these might not be enough to tell if someone is lying, for example.

Diagnostic test

Instead, he hopes it could be used in Alzheimer's and schizophrenia to help identify faults in the connections needed to perform everyday tasks. He also says the system might be useful for gauging emotional reactions to film clips and adverts.

How much detail such brain scans would show remains to be seen. "There would be a pretty coarse limit on what you could distinguish," says John Duncan of the UK Medical Research Council's Cognitive and Brain

Sciences Centre in Cambridge. "The distinctiveness of an activity predicts the distinctiveness of brain activity associated with it," he says.

Kay Brodersen of the Swiss Federal Institute of Technology in Zurich, Switzerland, agrees. "You might be able to tell if someone is singing to themselves," he says. "But try to distinguish a Lady Gaga song from another and you would probably fail."

"The most important potential for this is in the clinic where classifying and diagnosing and treating psychiatric disease could be really important," says Brodersen. "At the moment, psychiatry is often just trial and error."

http://www.newscientist.com/article/dn20516-mindreading-scan-identifies-simple-thoughts.html?full=true&print=true

Common drug combo increases diabetes risk

- 17:51 26 May 2011 by **Peter Aldhous**

A combination of two common drugs – one an antidepressant, the other used to lower blood cholesterol – may put people at risk of developing diabetes. This unexpected finding shows the benefits of data mining to discover hidden hazards lurking in our medicine cabinets.

Interactions between drugs can be hazardous or even fatal. When a particular combination of drugs is known to be dangerous a warning appears on the drugs' labelling, but there are many potential hazards that are not yet known about.

To look for drug combinations that might trigger diabetes, Nicholas Tatonetti and Russ Altman of Stanford University in California turned to a database called the Adverse Event Reporting System (AERS), run by the US Food and Drug Administration (FDA).

AERS contains reports from doctors whose patients have experienced drug side effects, but some researchers dismiss it as being too "noisy" to yield useful insights. One problem is that many adverse drug reactions never get reported. "There's a pretty big threshold for a physician to decide to submit a report to the FDA," Tatonetti explains.

And when a drug's hazards become well known, the database gets flooded with "me too" reports – for instance, AERS contains more than 70,000 reports about Vioxx, an anti-inflammatory painkiller that was withdrawn from sale in 2004 after being linked to deaths from heart attacks and stroke.

Blood sugar rise

When the team looked directly for drug combinations that caused blood sugar to rise – a symptom commonly associated with the onset of diabetes – they drew a blank, so instead they decided to combine a list of drugs known to affect pathways involved in diabetes, and then mined AERS for side effects associated with these drugs. Then they set their algorithms loose on AERS to find combinations of drugs that produced the same constellation of side effects, thinking that these might also affect pathways involved in diabetes.

One combination stood out: the antidepressant paroxetine and pravastatin, used to lower blood cholesterol.

Next, the Stanford researchers teamed up with colleagues at Harvard University and Vanderbilt University in Nashville, Tennessee, to study the electronic medical records of patients given both drugs. For patients treated at hospitals with ties to each of the three universities, the combination of paroxetine and pravastatin caused blood sugar to rise – especially in patients who were already diabetic.

Finally, the researchers showed that mice made "pre-diabetic" by giving them a diet laden with fat and sugar showed a similar spike in blood sugar when given the drug combination. Neither drug caused blood sugar to rise when given alone.

Tatonetti and Altman estimate that as many as 715,000 Americans were given paroxetine together with pravastatin in 2009. For those with diabetes, the combination's effect on blood sugar may mean that they need to take higher doses of drugs to control the condition; for others it could push them over the threshold into becoming diabetic.

Exactly why the drug combination should trigger a rise in blood sugar is unclear. The problem doesn't occur when you combine other selective serotonin reuptake inhibitors with statins, the classes of drugs to which

paroxetine and pravastatin belong. "We were very surprised that it was so specific to these two drugs," Tatonetti says.

The researchers are optimistic that a similar approach will uncover drug combinations that trigger high blood pressure, elevated blood cholesterol and depression.

Nigam Shah, a specialist in biomedical informatics at Stanford who was not involved in the research, now wants to try the approach for himself. "After reading the paper, I will probably try out their method on the roughly one million patients' worth of electronic medical records that my group is analysing," he says.

Journal reference: *Clinical Pharmacology and Therapeutics*, DOI: 10.1038/clpt.2011.83

http://www.newscientist.com/article/dn20515-common-drug-combo-increases-diabetes-risk.html

Genes, germs and the origins of politics

- 24 May 2011 by **Jim Giles**

Healthy democracy (Image: Andrio Abero at Dutchuncle.com)

A controversial new theory claims fear of infection makes the difference between democracy and dictatorship

COMPARE these histories. In Britain, democracy evolved steadily over hundreds of years. During the same period, people living in what is now Somalia had many rulers, but almost all deprived them of the chance to vote. It's easy to find other stark contrasts. Citizens of the United States can trace their right to vote back to the end of the 18th century. In Syria, many citizens cannot trace their democratic rights anywhere - they are still waiting for the chance to take part in a meaningful election.

Conventional explanations for the existence of such contrasting political regimes involve factors such as history, geography, and the economic circumstances and culture of the people concerned, to name just a few. But the evolutionary biologist Randy Thornhill has a different idea. He says that the nature of the political system that holds sway in a particular country - whether it is a repressive dictatorship or a liberal democracy - may be determined in large part by a single factor: the prevalence of infectious disease.

It's an idea that many people will find outrageously simplistic. How can something as complex as political culture be explained by just one environmental factor? Yet nobody has managed to debunk it, and its proponents are coming up with a steady flow of evidence in its favour. "It's rather astonishing, and it could be true," says Carlos Navarrete, a psychologist at the Michigan State University in East Lansing.

Thornhill is no stranger to controversy, having previously co-authored *A Natural History of Rape*, a book proposing an evolutionary basis for rape. His iconoclastic theory linking disease to politics was inspired in part by observations of how an animal's development and behaviour can respond rapidly to physical dangers in a region, often in unexpected ways. Creatures at high risk of being eaten by predators, for example, often reach sexual maturity at a younger age than genetically similar creatures in a safer environment, and are more likely to breed earlier in their lives. Thornhill wondered whether threats to human lives might have similarly influential consequences to our psychology.

The result is a hypothesis known as the parasite-stress model, which Thornhill developed at the University of New Mexico, Albuquerque, with his colleague Corey Fincher.

Xenophobic instincts

The starting point for Thornhill and Fincher's thinking is a basic human survival instinct: the desire to avoid illness. In a region where disease is rife, they argue, fear of contagion may cause people to avoid outsiders, who may be carrying a strain of infection to which they have no immunity. Such a mindset would tend to make a community as a whole xenophobic, and might also discourage interaction between the various groups within a society - the social classes, for instance - to prevent unnecessary contact that might spread disease. What is more, Thornhill and Fincher argue, it could encourage people to conform to social norms and to respect authority, since adventurous behaviour may flout rules of conduct set in place to prevent contamination.

Taken together, these attitudes would discourage the rich and influential from sharing their wealth and power with those around them, and inhibit the rest of the population from going against the status quo and questioning the authority of those above them. This is clearly not a situation conducive to democracy. When the threat of disease eases, however, these influences no longer hold sway, allowing forces that favour a more democratic social order to come to the fore.

That's the idea, anyway. But where is the evidence?

The team had some initial support from earlier studies that had explored how a fear of disease affects individual attitudes. In 2006, for example, Navarrete found that when people are prompted to think about disgusting objects, such as spoilt food, they become more likely to express nationalistic values and show a greater distrust of foreigners (*Evolution and Human Behavior*, vol 27, p 270). More recently, a team from Arizona State University in Tempe found that reading about contagious illnesses made people less adventurous and open to new experiences, suggesting that they have become more inward looking and conformist (*Psychological Science*, vol 21, p 440).

Temporarily shifting individual opinions is one thing, but Thornhill and Fincher needed to show that these same biases could change the social outlook of a whole society. Their starting point for doing so was a description of cultural attitudes called the "collectivist-individualist" scale. At one end of this scale lies the collectivist outlook, in which people place the overall good of society ahead of the freedom of action of the individuals within it. Collectivist societies are often, though not exclusively, characterised by a greater respect for authority - if it's seen as being necessary for the greater good. They also tend to be xenophobic and conformist. At the other end there is the individualist viewpoint, which has more emphasis on openness and freedom for the individual.

Pathogen peril

In 2008, the duo teamed up with Damian Murray and Mark Schaller of the University of British Columbia in Vancouver, Canada, to test the idea that societies with more pathogens would be more collectivist. They rated people in 98 different nations and regions, from Estonia to Ecuador, on the collectivist-individualist scale, using data from questionnaires and studies of linguistic cues that can betray a social outlook. Sure enough, they saw a correlation: the greater the threat of disease in a region, the more collectivist people's attitudes were (*Proceedings of the Royal Society B*, vol 275, p 1279). The correlation remained even when they controlled for potential confounding factors, such as wealth and urbanisation.

A study soon followed showing similar patterns when comparing US states. In another paper, Murray and Schaller examined a different set of data and showed that cultural differences in one collectivist trait - conformity - correlate strongly with disease prevalence (*Personality and Social Psychology Bulletin*, vol 37, p 318).

Thornhill and Fincher's next challenge was to find evidence linking disease prevalence not just with cultural attitudes but with the political systems they expected would go with them. To do so, they used a 66-point scale of pathogen prevalence, based on data assembled by the Global Infectious Diseases and Epidemiology Online Network. They then compared their data set with indicators that assess the politics of a country. Democracy is a tough concept to quantify, so the team looked at a few different measures, including the Freedom House Survey, which is based on the subjective judgements of a team of political scientists working for an independent American think tank, and the Index of Democratization, which is based on estimates of voter participation (measured by how much of a population cast their votes and the number of referendums offered to a population) and the amount of competition between political parties.

The team's results, published in 2009, showed that each measure varied strongly with pathogen prevalence, just as their model predicted (*Biological Reviews*, vol 84, p 113). For example, when considering disease prevalence, Somalia is 22nd on the list of nations, while the UK comes in 177th. The two countries come out at opposite ends of the democratic scale (see "An infectious idea").

Read more: Explore the full data with our interactive graphic

Importantly, the relationship still holds when you look at historical records of pathogen prevalence. This, together with those early psychological studies of immediate reactions to disease, suggests it is a nation's health driving its political landscape, and not the other way around, according to the team.

Last year, they published a second paper that used more detailed data of the diseases prevalent in each region. They again found that measures of collectivism and democracy correlate with the presence of diseases that are passed from human to human - though not with the prevalence of diseases transmitted directly from animals to humans, like rabies (*Evolutionary Psychology*, vol 8, p 151). Since collectivist behaviours would be less important for preventing such infections, this finding fits with Thornhill and Fincher's hypothesis.

"Thornhill's work strikes me as interesting and promising," says Ronald Inglehart, a political scientist at the University of Michigan in Ann Arbor who was unaware of it before we contacted him. He notes that it is consistent with his own finding that a society needs to have a degree of economic security before democracy can develop. Perhaps this goes hand in hand with a reduction in disease prevalence to signal the move away from collectivism, he suggests.

Inglehart's comments nevertheless highlights a weakness in the evidence so far assembled in support of the parasite-stress model. An association between disease prevalence and democracy does not necessarily mean that one drives the other. Some other factor may drive both the prevalence of disease in an area and its political system. In their 2009 paper, Thornhill and Fincher managed to eliminate some of the possible "confounders". For example, they showed that neither a country's overall wealth nor the way it is distributed can adequately explain the link between the prevalence of disease there and how democratic it is.

But many other possibilities remain. For example, pathogens tend to be more prevalent in the tropics, so perhaps warmer climates encourage collectivism. Also, many of the nations that score high for disease and low for democracy are in sub-Saharan Africa, and have a history of having been colonised, and of frequent conflict and foreign exploitation since independence. Might the near-constant threat of war better explain that region's autocratic governments? There's also the possibility that education and literacy would have an impact, since better educated people may be more likely to question authority and demand their rights to a democracy. Epidemiologist Valerie Curtis of the London School of Hygiene and Tropical Medicine thinks such factors might be the ones that count, and says the evidence so far does not make the parasite-stress theory any more persuasive than these explanations.

Furthermore, some nations buck the trend altogether. Take the US and Syria, for example: they have sharply contrasting political systems but an almost identical prevalence of disease. Though even the harshest critic of the theory would not expect a perfect correlation, such anomalies require some good explanations.

Also lacking so far in their analysis is a coherent account of how historical changes in the state of public health are linked to political change. If Thornhill's theory is correct, improvements in a nation's health should lead to noticeable changes in social outlook. Evidence consistent with this idea comes from the social revolution of the 1960s in much of western Europe and North America, which involved a shift from collectivist towards individualist thinking. This was preceded by improvements in public health in the years following the second world war - notably the introduction of penicillin, mass vaccination and better malaria control.

There are counter-examples, too. It is not clear whether the opening up of European society during the 18th century was preceded by any major improvements in people's health, for example. Nor is there yet any clear evidence linking the current pro-democracy movements in the Middle East and north Africa to changes in disease prevalence. The theory also predicts that episodes such as the recent worldwide swine-flu epidemic should cause a shift away from democracy and towards authoritarian, collectivist attitudes. Yet as Holly Arrow, a psychologist at the University of Oregon in Eugene, points out, no effect has been recorded.

Mysterious mechanisms

To make the theory stick, Thornhill and his collaborators will also need to provide a mechanism for their proposed link between pathogens and politics. If cultural changes are responsible, young people might learn to avoid disease - and outsiders - from the behaviour of those around them. Alternatively, the reaction could be genetically hard-wired. So far, it has not proved possible to eliminate any of the possible mechanisms. "It's an enormous set of unanswered questions. I expect it will take many years to explore," Schaller says.

One possible genetic explanation involves *5-HTTLPR*, a gene that regulates levels of the neurotransmitter serotonin. People carrying the short form of the gene are more likely to be anxious and to be fearful of health risks, relative to those with the long version. These behaviours could be a life-saver if they help people avoid situations that would put them at risk of infection, so it might be expected that the short version of the gene is favoured in parts of the world where disease risk is high. People with the longer version of *5-HTTLPR*, on the other hand, tend to have higher levels of serotonin and are therefore more extrovert and more prone to risk-taking. This could bring advantages such as an increased capacity to innovate, so the long form of the gene should be more common in regions relatively free from illness.

That pattern is exactly what neuroscientists Joan Chiao and Katherine Blizinsky at Northwestern University in Evanston, Illinois, have reported in a paper published last year. Significantly, nations where the short version of the gene is more common also tend to have more collectivist attitudes (*Proceedings of the Royal Society B*, vol 277, p 529).

It is only tentative evidence, and some doubt that Chiao and Blizinsky's findings are robust enough to support their conclusions (*Proceedings of the Royal Society B*, vol 278, p 329). But if the result pans out with further research, it suggests the behaviours involved in the parasite-stress model may be deeply ingrained in our genetic make-up, providing a hurdle to more rapid political change in certain areas. While no one is saying that groups with a higher proportion of short versions of the gene will never develop a democracy, the possibility that some societies are more genetically predisposed to it than others is nevertheless an uncomfortable idea to contemplate.

Should the biases turn out to be more temporary - if flexible psychological reactions to threat, or cultural learning, are the more important mechanisms - the debate might turn to potential implications of the theory. Projects aiming to improve medical care in poor countries might also lead a move to more democratic and

open governments, for example, giving western governments another incentive to fund these schemes. "The way to develop a region is to emancipate it from parasites," says Thornhill.

Remarks like that seem certain to attract flak. Curtis, for instance, bristled a little when *New Scientist* put the idea to her, pointing out that the immediate threat to human life is a pressing enough reason to be concerned about infectious disease.

Thornhill still has a huge amount of work ahead of him if he is to provide a convincing case that will assuage all of these doubts. In the meantime, his experience following publication of *A Natural History of Rape* has left him prepared for a hostile reception. "I had threats by email and phone," he recalls. "You're sometimes going to hurt people's feelings. I consider it all in a day's work."

Jim Giles *is a New Scientist correspondent based in San Francisco*

http://www.newscientist.com/article/mg21028133.300-genes-germs-and-the-origins-of-politics.html

Rewriting the textbooks: Hydrogen bonds in a bind

- 25 May 2011 by **Katharine Sanderson**

A more fluid bond (Image: Bally Scanlon/Getty)

There is a reason why ice floats on water, and it is called the hydrogen bond. Whatever that is.

Nobel laureate Linus Pauling thought he knew. In fact, the International Union of Pure and Applied Chemistry (IUPAC), which concerns itself with such things, still bases its official definition on the one that appears in Pauling's classic 1939 book *The Nature of the Chemical Bond*.

A hydrogen bond, in this picture, is what forms when a hydrogen atom that is already stably bound into one molecule finds itself attracted to a highly electronegative atom - one like oxygen, nitrogen or fluorine that likes to suck in electrons and turn into a negatively charged ion - elsewhere in the same molecule or in a nearby molecule.

Take good old H_2O. The two hydrogen atoms of a water molecule are bound covalently, through shared electrons, to its central oxygen atom. But should a second water molecule come near, the electron orbiting one of the hydrogen atoms can be drawn towards the second molecule's electron-hungry oxygen.

Ice is less dense than liquid water because, when water molecules are cold and still, weak hydrogen bonds between them keep them consistently at arm's length. In free-flowing water, however, the bonds are continually breaking and reforming, allowing the molecules to jostle closer together.

That is all fine and dandy. But this traditional picture also implies a strict range of admissible hydrogen-bond strengths. Over the past 40 years, though, reams of evidence about much weaker bonds, including ones between hydrogen and elements like carbon, which are not very electronegative, have come to light.

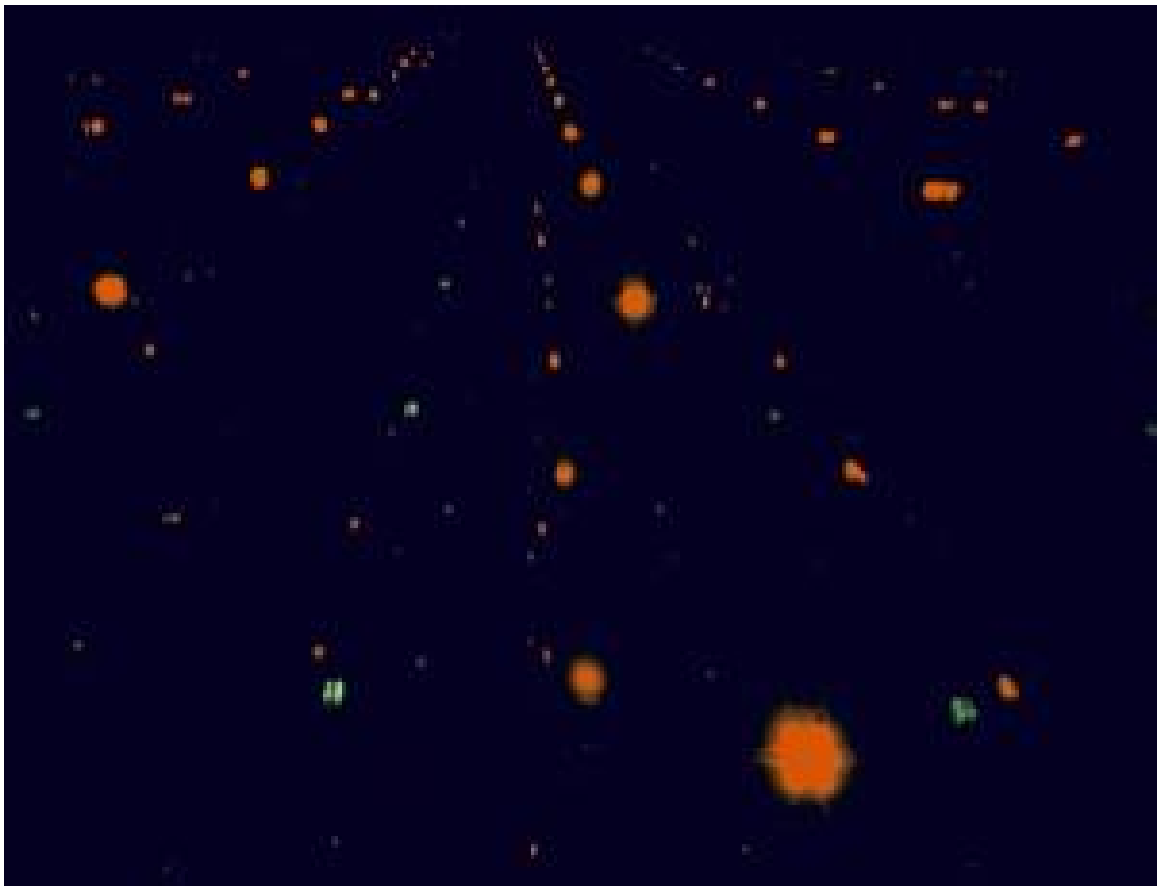
Six years ago, IUPAC set up a committee to clear up the confusion. Its conclusion, set out in a seven-page draft redefinition published last year, is that the hydrogen bond is a far fuzzier entity than we thought. "It is not an interaction with sharp boundaries," says Gautam Desiraju from the Indian Institute of Science in Bangalore, a member of the IUPAC committee.

This is about more than just semantics, Desiraju says. A new definition will counter a widespread misconception among chemists about when and where hydrogen bonds can occur, and encourage them to consider the bond's influence in new situations - for example, in allowing organic molecules to form and react in ways never thought possible. Exploring such avenues could help steer us away from our current dependence on toxic and expensive catalysts containing precious metals towards cheaper, greener organic-based alternatives.

http://www.newscientist.com/article/mg21028132.700-rewriting-the-textbooks-hydrogen-bonds-in-a-bind.html?full=true&print=true

Rewriting the textbooks: Confusion over nuclear fission

- 24 May 2011 by **Kate McAlpine**
- Magazine issue 2813.



Just add magic (Image: Gjon Mili/Getty)

We've built the bomb. We've built the reactors that provide us with vast amounts of low-carbon power. If that seems remarkable, it becomes all the more so when you realise that the whole enterprise of nuclear fission is based on a misunderstanding.

This much we thought we knew: when a susceptible element undergoes fission, it will split into roughly equal parts, and if it doesn't, it is down to "magic" numbers. These numbers spring from an elaborate, but slightly shaky, construction for understanding atomic nuclei. It starts off by imagining a nucleus as a drop of a strangely viscous liquid. When this doesn't quite deliver the desired results, it adds on "shells" that, like the electron shells envisaged to form an atom's outer coat, can each hold a certain number of protons and neutrons.

Just as an atom with a full outer electron shell is a peculiarly unreactive noble gas, an outer shell with the right number of protons and neutrons makes a nucleus magically stable. So if an atom doesn't split in exact halves, it will preferentially split to make a magic nucleus or two.

Last year, these ideas were put to the test at ISOLDE, a facility for making rare radioactive isotopes at CERN near Geneva, Switzerland, to predict the outcome of fissioning mercury-180. Dividing mercury-180 evenly gives two zirconium-90 nuclei, which just happen to have a magic number of neutrons and an almost magic number of protons. Given all that, says Phil Walker of the University of Surrey in Guildford, UK, to expect exactly that outcome is "a no-brainer".

Sadly, mercury-180 doesn't play by the rules. It divides asymmetrically into the distinctly unmagical nuclei ruthenium-100 and krypton-80 (*Physical Review Letters*, vol 105, p 252502).

"It's surprising that a process as basic as fission so obviously does not agree with what is expected," says Walker. The forgotten factor, the ISOLDE team proposes, is time. As a nucleus splits, it elongates and a neck appears between two lobes. Some nuclei, perhaps, simply cannot reach a symmetrical equilibrium before that neck breaks. But as for what nuclear factors determine that - there, the experts are split.

http://www.newscientist.com/article/mg21028132.600-rewriting-the-textbooks-confusion-over-nuclear-fission.html?full=true&print=true

Unbreakable: Beale's buried treasure

- 26 May 2011 by **MacGregor Campbell**
- Magazine issue 2813

The clue to untold riches, or an elaborate hoax? (Image: Public Domain)

Three coded messages published in 1885 hold the location of treasure buried in Virginia – or was it a hoax? We still don't know

In 1885, James B. Ward published *The Beale Papers*, a pamphlet containing three coded messages, the solution of which, Ward claimed, would lead to sizeable buried treasure in Bedford county, Virginia.

According to the pamphlet, 60 years earlier the eponymous Beale left a small locked box containing the codes with an innkeeper before disappearing. The innkeeper passed the messages to a friend, who solved only one of the puzzles - the one detailing the vast riches awaiting whomever could solve the other two.

The solved code featured numbers that corresponded to the initial letters of the words in the US Declaration of Independence. The code was a string of numbers, so 12, for example, referred to the first letter of the twelfth word in the Founding Fathers' text.

In 1980, Jim Gillogly used a computer to decode one of the remaining unsolved codes. He found a number of anomalies, such as long strings of characters in alphabetical order, suggesting they are a hoax.

There have been many subsequent efforts to find the treasure - and even a Hollywood movie called *National Treasure* inspired by the tale - but Gillogly has seen nothing in the past 30 years to make him doubt his original assessment. "I'm quite confident that they're a hoax," he told *New Scientist*.

http://www.newscientist.com/article/mg21028133.600-unbreakable-beales-buried-treasure.html?full=true&print=true

Ultracold measurements reveal shape of the electron

- 25 May 2011
- Magazine issue 2814.

WHAT shape is an electron? The standard model of particle physics predicts that electrons are egg-shaped, but that the amount of distortion from a perfect sphere is so tiny that no existing experiment could possibly detect it. However, a rival theory called supersymmetry predicts that this egg-shaped distortion should be large enough to be detectable.

Jony Hudson and colleagues at Imperial College London set out to crack the problem. They used ultracold molecules of ytterbium fluoride in which the centres of positive and negative charge differ, creating a dipole. The shape of this dipole reflects the asymmetry of the electron shape, and the team measured this by placing the molecules in an electric and a magnetic field and observing how they spin as the fields are changed. Variations in the rate of spin reveal any asymmetry. Their experiment measured the shape to within a few parts in 10^{18} but as far as they could tell, rather than being oval, the electron is spherical (*Nature*, DOI: 10.1038/nature10104).

The result is a challenge to supersymmetry: while the standard model suggests the electron is egg-shaped by only one part in 10^{28}, supersymmetry sets the range at between one part in 10^{14} and one part in 10^{19}.

"We cannot rule out supersymmetry but we're certainly putting pressure on the theory," says Hudson.

An improvement of one order of magnitude could either confirm supersymmetry or rule it out, something the Imperial team now aims to achieve.

http://www.newscientist.com/article/mg21028145.100-ultracold-measurements-reveal-shape-of-the-electron.html?full=true&print=true

African land grab could lead to future water conflicts

- 26 May 2011 by **Anil Ananthaswamy**
- Magazine issue 2814

"Virtual water" for export (Image: Tyler Hicks/The New York Times/Redux/Eyevine)

IS THIS the face of future water conflicts? China, India and Saudi Arabia have lately leased vast tracts of land in sub-Saharan Africa at knockdown prices. Their primary aim is to grow food abroad using the water that African countries don't have the infrastructure to exploit. Doing so is cheaper and easier than using water resources back home. But it is a plan that could well backfire.

"There is no doubt that this is not just about land, this is about water," says Philip Woodhouse of the University of Manchester, UK.

Take Saudi Arabia, for instance. Between 2004 and 2009, it leased 376,000 hectares of land in Sudan to grow wheat and rice. At the same time the country cut back on wheat production on home soil, which is irrigated with water from aquifers that are no longer replenished - a finite resource.

Meanwhile, firms from China and India have leased hundreds of thousands of hectares of farmland in Ethiopia. Both China and India have well-developed irrigation systems, but Woodhouse says their further development - moving water from the water-rich south to northern China, for instance - is likely to be more costly than leasing land in Africa, making the land-grab a tempting option.

But why bother leasing land instead of simply importing food? Such imports are equivalent to importing "virtual water", since food production accounts for nearly 80 per cent of annual freshwater usage. A new study into how this virtual water moves around the world offers an explanation for the leasing strategy. Ignacio Rodriguez-Iturbe of Princeton University and Samir Suweis of the Swiss Federal Institute of Technology in Lausanne have built the first mathematical model of the global virtual water trade network, using the UN Food and Agricultural Organization's data on trade in barley, corn, rice, soya beans, wheat, beef, pork, and poultry in 2000. They combined this with a fine-grained hydrological model (*Geophysical Research Letters*, DOI: 10.1029/2011GL046837).

The model shows that a small number of countries have a large number of connections to other countries, offering them a steady and cheap supply of virtual water even if some connections are compromised by

drought or political upheaval. A much larger number of countries have very few connections and so are vulnerable to market forces.

Most importantly, the model shows that about 80 per cent of the water flows over only about 4 per cent of the links, which Rodriguez-Iturbe calls the "rich club phenomenon". In total, the model shows that in 2000, there were 6033 links between 166 nations. Yet 5 per cent of worldwide water flow was channelled through just one link between two "rich club" members - the US and Japan.

The power of the rich club may yet increase. The model allows the team to forecast future scenarios - for example, how the network will change as droughts and spells of violent precipitation intensify due to climate change. Predictably, this will only intensify the monopoly, says Suweis. "The rich get richer."

China and India are not currently major players in the virtual water network on a per capita basis, and as the network evolves they could find themselves increasingly vulnerable to market forces and end up paying more for the food they import. Leasing land elsewhere is an attempt to secure their food and water supply in a changing world. But it could be a short-sighted move.

Last year, Paolo D'Odorico of the University of Virginia at Charlottesville showed that a rise in the virtual water trade makes societies less resilient to severe droughts (*Geophysical Research Letters*, DOI: 10.1029/2010GL043167). "[It] causes a disconnect between societies and the water they use," says D'Odorico. The net effect is that populations in nations that import water can grow without restraint since they are not limited by water scarcity at home.

Although this could be seen as a good thing, it will lead to greater exploitation of the world's fresh water. The unused supplies in some areas that are crucial in case of major droughts in other areas will dry up. "In case of major droughts we [will] have less resources available to cope with the water crisis," says D'Odorico.

In the end, then, the hunt for water that is driving emerging economies to rent African land to grow their crops could come back to haunt them.

http://www.newscientist.com/article/mg21028144.100-african-land-grab-could-lead-to-future-water-conflicts.html?full=true&print=true

People in threatened societies are more conformist

- 19:00 26 May 2011 by **Michael Marshall**

Societies facing a host of dangers are more likely to have strict social norms and be intolerant of people who deviate from them. The more secure a society, the more liberal and tolerant its people.To find out how strict social norms are in different places, Michele Gelfand of the University of Maryland in College Park, and colleagues, surveyed 6800 people in 33 countries. They used the results to give each country a "tightness" figure, reflecting how many social norms there were and how strictly they were enforced.

"Tight" countries like India and South Korea had more and stricter social norms than "loose" countries like the Netherlands and Estonia. People in tight countries thought only a small range of behaviours was acceptable in everyday situations such as eating in a restaurant.And they were more likely to condemn prostitution, abortion, divorce, cheating, avoiding a fare on public transport and accepting a bribe. There was less diversity of opinion, religion was more prominent, and their governments were more autocratic.

Healthy response?

Gelfand then pulled together data on the threats each country faced from high population density, shortages of food and clean water, pollution, natural disasters, diseases and hostile neighbours. All of these threats were more prevalent in tight countries.

Becoming socially tight may be a healthy response to threats, Gelfand says. She suggests that an embattled society might have a better chance of surviving if it became tighter.

But that doesn't necessarily follow, says Randy Thornhill of the University of New Mexico in Albuquerque. He says it is not obvious that conformity would be a defence against so many different threats.

Thornhill has gathered some evidence that societies with higher rates of infectious disease are less democratic and more conformist, and argues that that is because such strictness reduces the risk of contamination (see "Genes, germs and the origins of politics").

Points of view

Gelfand's findings could fit that interpretation, but Thornhill says threats like food shortages or natural disasters would actually be better handled by openness and tolerance, which allow new ideas and technologies to develop. "The advantages of not conforming are tremendous," he says.There's another reason to recognise the difference between tight and loose societies. Gelfand says encounters between people in different societies may lead to misunderstandings and conflicts. "Permissiveness and looseness can be viewed very negatively from the standpoint of tight societies," Gelfand says. "At the same time, constraint and suppression can be seen as immoral from the standpoint of loose societies."

Thornhill disagrees, pointing out that on average, loose societies engage in far fewer wars than tight societies. He says liberal countries are "more understanding of differences in other countries", whereas tight countries are more xenophobic generally.

Journal reference: *Science*, DOI: 10.1126/science.1197754

http://www.newscientist.com/article/dn20510-people-in-threatened-societies-are-more-conformist.html?full=true&print=true

Novel design could help probe explore frozen environs on Earth and beyond.

Adam Mann

The IceMole team loads their hybrid probe into its launch rack.FH Aachen / www.lichtographie.de

Getting a probe to travel five metres might not seem like a much of a reason to celebrate. But after Bernd Dachwald and his team watched their IceMole robot autonomously drill through a small section of Morteratsch Glacier in Switzerland during the summer of 2010, they held a small party.

"This was a major milestone," says Dachwald, an aerospace engineer at Fachhochschule Aachen University of Applied Sciences in Aachen, Germany. On 27 April, Dachwald presented results from IceMole's first field test at the 2011 Antarctic Science Symposium in Madison, Wisconsin. "We have proof that IceMole works not only in the lab but also in a real environment," he says.

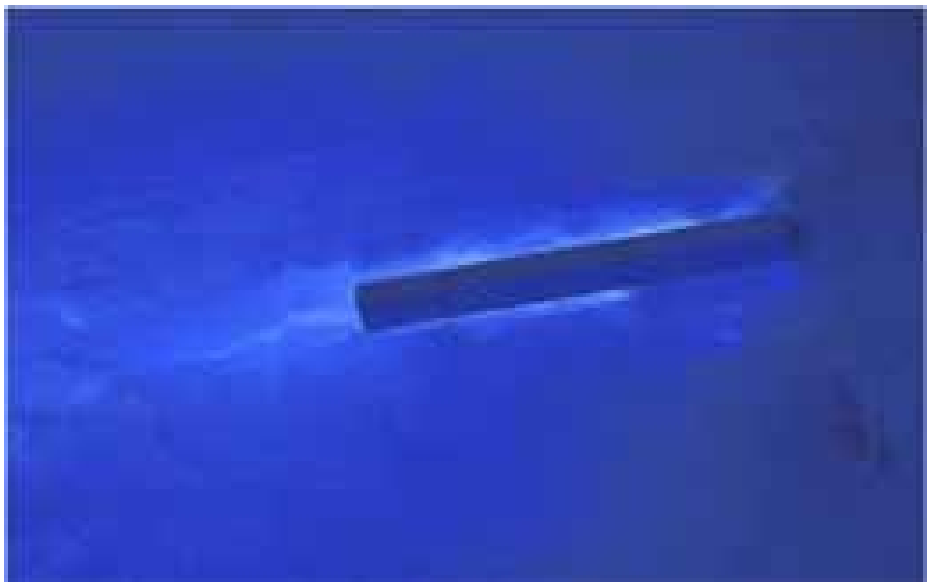
After two years of work, the researchers believe they have developed a new type of ice-melting probe, which may one day penetrate sub-surface lakes in the Antarctic, dig through the ice caps of Mars or churn through the frozen crust of Europa.

Probes with heated tips have been used since the 1960s to bore through ice, but engineers found that dirt and sediment would often build up at the robot's head, impeding the transfer of heat. And most of these designs had the capacity to move in only one direction: down.

IceMole includes a six-centimetre screw at its heated head, which allows it to keep in firm contact with the ice surface it is trying to melt. The screw's grip means the probe can pull itself horizontally through ice layers and even upward, against gravity. The configuration permits the robot to easily penetrate dirt and should even work in places where the ice is in a near vaccuum, such as a comet's nucleus, says Dachwald.

An artistic impression of IceMole worming its way through solid ice.FH Aachen

The pencil-shaped craft is designed to autonomously deploy and dig itself into ice. By differentially heating parts of its tip, the robot can change direction. During its first trial run, IceMole moved at a leisurely 30 centimetres per hour, but the team says that optimal conditions would allow it to travel at more than three times that speed.



The robot houses its own internal power generator and is attached by means of a cable to a computer at the surface, which collects data. In its recent test, IceMole carried an off-the-shelf camera, but the team is designing fluorescence biosensor detectors that could search for organic molecules in the ice during its next trial run, scheduled for the summer of 2012. The probe will convey sensors in five containers running behind it, tethered together like the cars of a train. These canisters can be jettisoned on command, to seize the walls of the melted channel and be placed in specific locations.

Sterile sampling

The team hopes to eventually work with other researchers that would use IceMole to drop sensors deep in icy environments. "We like are engineers building a spacecraft; we need some scientists to build the payload," says Dachwald.

Already, a French team has expressed interest in using the probe to search for micrometeorites in ice, he says. Because it uses no external fluids to aid its movement through the ice, the robot could prove to be an ideal tool for sampling sub-glacial lakes in Antarctica while minimizing the risk of contamination from the surface, says Ryan Bay, a physicist at the University of California in Berkeley who works on the IceCube Neutrino Observatory at the South Pole and who co-organized the 2011 Antarctic Science Symposium. The IceMole team is working on a sterilization method that would drive the whole probe through a bath of hydrogen peroxide before deployment.

Beyond Earth, the robot could drill into the martian ice caps, searching for clues about the planet's climate history or signs of life, past or present. Because it can bore through dirty ice, IceMole might also be useful on comet missions to investigate their porosity and chemical makeup, says Dachwald. Ultimately, the team's design could be used on a probe headed for icy outer moons such as Europa and Enceladus to ferret around for indications of sub-surface water and living organisms.

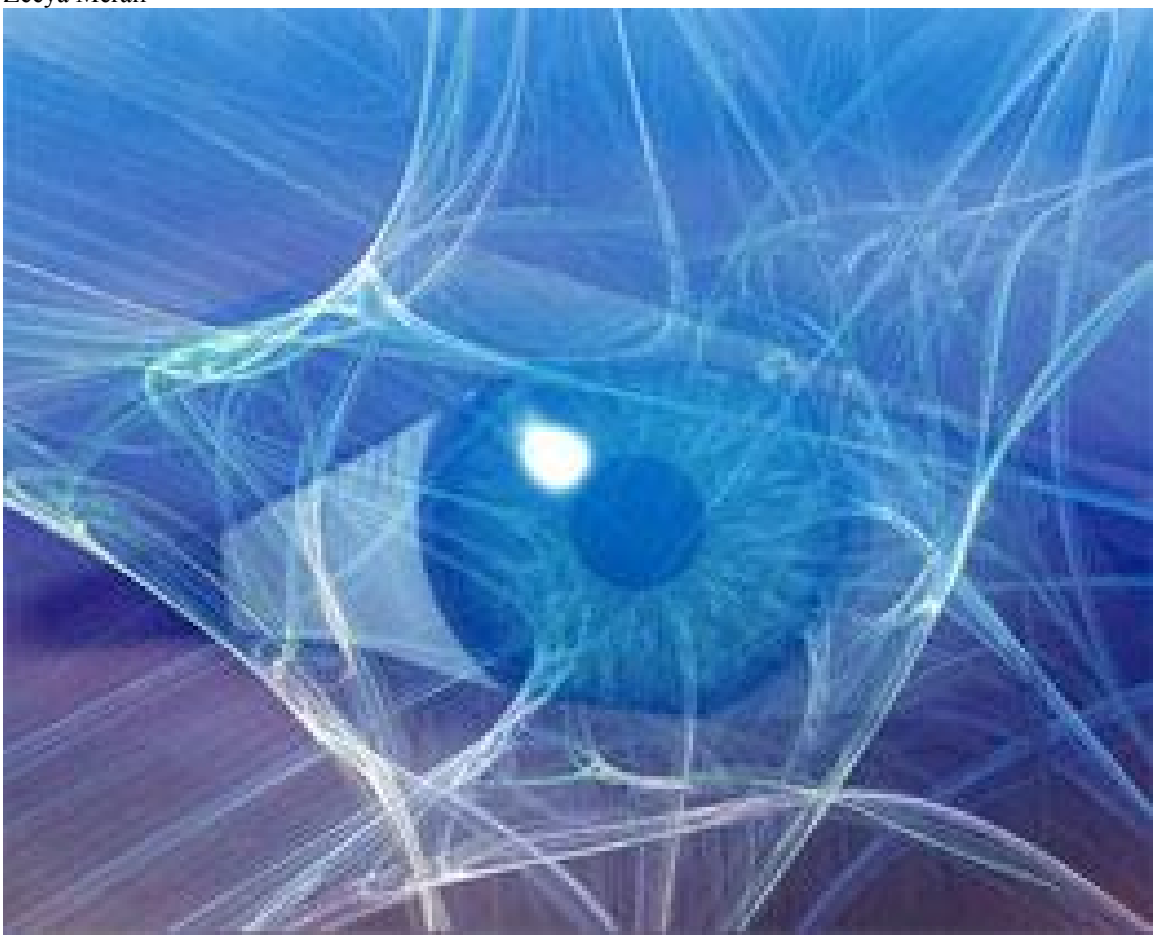
The device's capabilities have impressed other researchers. "It's a nice little design," says Wayne Zimmerman of NASA's Jet Propulsion Laboratory in Pasadena, California, who was the lead engineer on Cryobot, a heated ice probe that also has planetary scientists thinking about ways to explore some of the solar system's iciest environments. But Zimmerman cautions that any space-based missions would be likely to require design changes, such as building a smaller, lighter and more independent probe, to accommodate launch and landing on a distant surface.

"Making the transition from terrestrial testing to planetary exploration is a leap and a bound," he says.

http://www.nature.com/news/2011/110430/full/news.2011.261.html

Quantum effects brought to light

Results of entanglement made visible to human eyes.
Zeeya Merali



By linking a single photon to a field of thousands, researchers have made the invisible visible.Equinox Imagery / Alamy

It's an eye test with a quantum twist: physicists have used humans to detect the results of a quantum phenomenon for the first time.

Nicolas Gisin, a physicist at the University of Geneva in Switzerland, devised a new test to see if the human eye could pick out signs of 'entanglement'[1]. This weird quantum effect inextricably links two or more objects in such a way that measurements carried out on one immediately change the properties of its partners, no matter how far apart they are. Quantum effects, such as entanglement, are usually confined to the invisible microscopic world and are detected only indirectly using precision instruments.

Gisin and his colleagues were inspired by an experiment carried out in 2008 by Fabio Sciarrino and his team at La Sapienza University in Rome, Italy[2]. Usually, physicists working with entangled photons only deal with a small number at a time. In the Rome experiment, the physicists entangled a pair of photons and then 'amplified' one of them to create a shower of thousands of photons with the same quantum state. In this way, one 'microscopic' photon seemingly became entangled with thousands of others in a 'macroscopic' light field.

"I immediately realized that the human eye could see that many photons," says Gisin.

Using a similar set-up to that of Sciarrino, Gisin and his team entangled two photons. One was sent to a standard photon detector, while the other was amplified using a machine that generated a shower of photons with the same polarization, thereby, in theory, generating a micro–macro entangled state.

But Gisin replaced the photon detector Sciarrino used for the light field with a human. The beam of light produced by the amplifier could appear in one of two positions, and the location of the beam reflected the polarization state of the photons in the field. Gisin and his team sat in the dark for hours, marking the position of the light spot over repeated runs of the experiment, for the first time seeing the effects of quantum entanglement with the naked eye.

Like Sciarrino's group, Gisin and his team used the standard test for entanglement, known as a Bell test, to compare how well the polarization of the single photon and the light field matched up. This test sets a level for the correlation of states between the two objects above which their entanglement is confirmed. And, like the Rome group, Gisin's team got a positive result.

The results of the human 'detectors' were checked with photon detectors, and they matched — although the latter were "faster and more reliable than humans and didn't complain of tiredness", Gisin says

More than meets the eye

But there was a hitch. What Gisin's team saw was not micro-macro entanglement. Gisin had a nagging suspicion that the Bell test may not be valid for macroscopic objects, so he deliberately set up the experiment so that the state of the second photon was measured before it was amplified. According to the rules of quantum mechanics, this act of measurement would break the entanglement, meaning that the first photon and the light field could not be in an entangled state. The system should not have passed the Bell test.

"We set up the worst kind of amplifier precisely to see what result the standard Bell test would give, and it gave the wrong — positive — answer," says Gisin.

The reason for the false positive result is that no detector — human or mechanical — is perfect, says Gisin. Some photons will always be lost during the experiment — an effect known as the detection loophole. Normally, this does not affect the Bell test, but Gisin says that as more photons come into play, the loophole hugely distorts the results. So regardless of whether or not Sciarrino and his team did create micro–macro entanglement in their 2008 experiment, the Bell test would always give a positive result, says Gisin.

"This is brilliant work showing that if we do not control everything in the experiment, we can be fooled into thinking we have seen a macroscopic quantum effect, when we haven't," says Magdalena Stobińska, a quantum physicist at the Max Planck Institute for the Science of Light in Erlangen, Germany.

Sciarrino is not surprised by the results. He and his team had already realized that they could not trust their Bell test, and are working on a new way to verify micro–macro entanglement. They plan to use a laser to boost the light signal from the photon field to improve its chances of detection[3]. "Unfortunately, we cannot do this experiment with humans as detectors because the laser would burn out their eyes," Sciarrino says.

Even though Gisin's team did not see micro-macro entanglement, he notes that the positive Bell test does show that the original pair of single photons was entangled before amplification, confirming micro-micro entanglement existed at the start of the experiment.

"The experiment is lovely because in this sense you can 'see' entanglement," says Sciarrino. "It brings quantumness closer to human experience."

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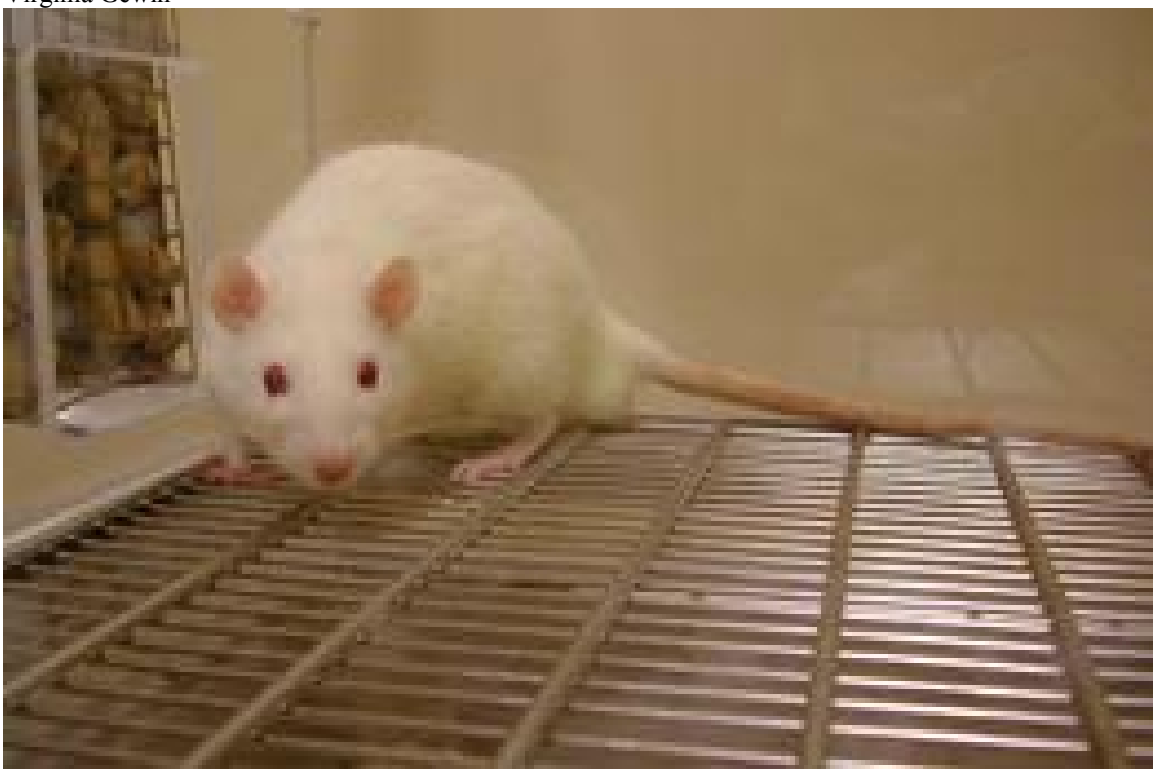
Surreptitious sleep states uncovered

Sleep-deprived rats suggest sleep is not necessarily a whole-brain phenomenon.
Virginia Gewin



This rat is not as alert as it looks.Yuval Nir

The closed eyes, the unresponsiveness, the drool — sleep is an easily recognizable, all-encompassing state. But the divide between sleep and wakefulness may not be as clearcut as we thought.

Research published today in Nature demonstrates that in visibly awake rats, neurons in some areas of the brain's cortex briefly go 'offline'. In these pockets, neuronal patterns resemble those associated with non-rapid eye movement (NREM) sleep[1].

"The rats were awake, but awake with a nice sprinkling of localized sleep in the cortex," says Guilio Tononi, a neuroscientist at the University of Wisconsin–Madison and lead author of the study.

The team used different techniques to measure both the local and global electric field potentials in the brain. Localized neural activity was measured using microwire arrays implanted deep in the frontal and parietal cortex field, whereas electroencephalography (EEG) detects global neuronal activity such as slow waves seen in NREM sleep. During slow-wave activity, neurons oscillate between ON and OFF states, but are typically OFF.

By recording the activity of many small populations of neurons, Tononi and his colleagues showed that OFF states occur randomly throughout the cortex when a rat has been awake for a long time. "If we could watch the whole brain, it would be like watching boiling water - when you are awake, just before boiling, all the neurons are ON. As the animal gets tired, the OFF periods would then be the bubbles; where they appear is impossible to predict," he says.

Slow waves were thought to be absent during normal waking behaviour, but the new study emphasizes that slow-wave activity can be very localized, says David McCormick, a neurobiologist at Yale University in New Haven, Connecticut. "Call it a cortical blink — just a brief shutdown of a piece of cortex that can disrupt neural processing."

Napping neurons

The napping neurons can affect behaviour. The number of OFF periods grew as the length of time the animal had been kept awake rose, impairing its cognitive performance when challenged with a difficult task — reaching for a sugar pellet through a slot in their plexiglass cage.

Toroni notes that compared to the global phenomenon we recognize as sleep, the presence of localized OFF neurons "is more insidious because we can't tell it's happening". In humans, this could explain why sleep deprivation can impair judgment.

Interestingly, earlier this month Tononi and colleagues reported that, even during 'global' sleep, slow waves are localized and occur in specific regions[2]. They recorded the EEG and localized neuronal activity using deep electrodes in a number of brain regions in people undergoing brain surgery and found that the slow waves can propagate from the prefrontal cortex to the temporal lobe to the hippocampus. "Even in sleep, the slow waves were more local than expected," says Tononi.

Together, these findings suggest that scientists may have had an overly simplistic idea of waking and sleep states. "If these both happen — local sleep during waking and local waking during sleep — then it may lead to a rethinking of our concepts of sleep states," says Peter Achermann, a sleep researcher at the University of Zurich in Switzerland.

Redefining opposites

"This paper clearly confirms the suspicion that sleep can occur in parts of the brain when the rest of the brain is awake — that's what we see in the clinic," says Mark Mahowald, director of the Minnesota Regional Sleep Disorders Center in Minneapolis. Sleep-walking is the best example of how such simultaneous mixtures of wakefulness and sleep can result in complex behaviours, he adds.

Tononi agrees. "Our work doesn't redefine sleep — we have a good definition based on behavioural aspects — but it does suggest that the definition may not be sufficient to describe disassociated states."

This work may help to pin down a better understanding of the function of sleep — a long-term goal of Tononi's research group. "We suspect sleep has something to do with synapses because we find a net strengthening of synapses during sleep," he says. Sleep seems to be a time of recalibrating synaptic activity in the brain, so he wants to determine whether napping neurons in an awake brain are protective, restorative or just plain harmful.

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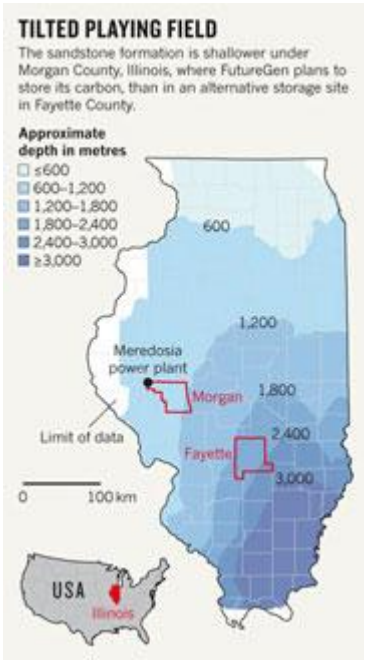
Is FutureGen betting on the wrong rock?

Commercial rival says gas spreading and leakage could harm US carbon-sequestration effort.
Jeff Tollefson
Kurt Zenz House watches from a corner office in Berkeley, California, as carbon dioxide is pumped into sandstone 2,000 metres below the southern Illinois farmland. A colourful plume grows on his computer screen, modelling the movement of CO_2 through the porous rock. As decades elapse in the simulation, the CO_2 rises and settles under the dome of shale that caps the formation.
House says that this is exactly what should happen. "CO_2 injected anywhere inside the geological boundary will stay within the boundary," he says. And, he argues, that is exactly what won't happen when FutureGen 2.0, the US government's main commercial demonstration project for carbon capture and sequestration (CCS), begins to store CO_2 from a coal-fired power plant in Illinois in 2015.



House's company, C12 Energy in Berkeley, is challenging the strategy that the project has chosen for sequestering the 1.3 million or so tonnes of CO_2 that it aims to capture each year. In its demonstration effort, FutureGen intends to inject the CO_2 into porous sandstone with no dome or other structure to help trap the gas — arguing in part that such formations are too rare to rely on for large-scale storage. But C12 and its backers, who advocated a rival site, say that the strategy risks legal and financial problems if the CO_2 spreads farther than expected.
Last February, FutureGen rejected C12's bid to handle the storage side of the project, so C12 is pushing ahead with plans to develop its own commercial sequestration operation. It is acquiring rights to pump CO_2 into its Illinois site — a domed reservoir in Fayette County 160 kilometres from the plant (see 'Tilted playing field') — and into reservoirs in eight other states in the hope that CCS will eventually become commonplace at other power plants.
Killed by US President George W. Bush in 2008, FutureGen was resurrected a year later by President Barack Obama as a centrepiece of his administration's strategy for climate change and energy. The project is a US$1.3-billion deal between the US Department of Energy and a group of major energy companies to capture and store CO_2 from the exhaust of a coal plant near Meredosia, Illinois. After rejecting C12's bid, FutureGen settled on a saline aquifer 1,200–1,500 metres deep in Morgan County, where the plant is located.
As well as lacking a structural trap, the sandstone in Morgan County sits at a slight angle and is shallower than that in Fayette County. All of this makes gas injected there likely to be more mobile and less predictable, says Daniel Schrag, a geochemist at Harvard University in Cambridge, Massachusetts. That could "poison the

well" for CCS if legal problems ensue, says Schrag, who was House's PhD adviser and now chairs C12's board of science advisers.
"Let's start with a viable project where the risk is as low as possible."

By trapping the injected CO_2 with geological structures, C12 says that it can minimize the number of leases for subsurface rights it needs to negotiate with landowners. In its bid, submitted in partnership with local governments, the company had offered to charge a flat fee of $140 million to handle everything at the storage site. The pipeline to carry the CO_2 from the plant would have cost another $100 million to $200 million.
FutureGen initially declined to talk about finances, saying only that the project would come in at or below budget. It now says that its approach will be cheaper, with a maximum budget of around $125 million for the sequestration work.
Kenneth Humphreys, chief executive of the FutureGen Alliance, says that the geology in Morgan County is both suitable and typical of what is readily available around the world. "We are focused on what could well be the workhorse solution," Humphreys says. C12's site is "interesting, but not nearly as common".

Wide spread

Outside experts say that it is hard to compare the sites until both have been fully characterized with modern seismic and other technologies. Although the type of structural containment proposed by C12 has advantages, it could be a disadvantage if a leak develops because all the CO_2 would escape from one place, says Susan Hovorka, a carbon-sequestration expert at the University of Texas at Austin.
Similarly, although a lack of containment might translate into a larger plume, the dispersed CO_2 is more likely to dissolve into groundwater or to remain trapped in pore space, adds Robert Finley, who heads the Advanced Energy Technology Initiative at the Illinois State Geological Survey. "The C12 guys have one approach," Finley says, "but I don't think the validity of their arguments necessarily negates other approaches."
But C12 and its supporters argue that structural closure lessens the risk of liability if CO_2 migrates into pore space for which the project has not secured legal access. "Let's start with a viable project where the risk is as low as possible," says Tony Meggs, a visiting engineer at the Massachusetts Institute of Technology in Cambridge, who chairs C12's board of directors.
Humphreys says that FutureGen plans to sign lease agreements for subsurface rights with the landowners who own the land above the plume's location, but that will be more difficult if the plume spreads. When initially considering potential sites, FutureGen assumed a plume size of roughly 4 square kilometres. Humphreys has since acknowledged that the CO_2 could end up spreading further, but the alliance won't know for sure until they have studied the geology of the site in detail. House says his team's modelling suggests that the gas could spread across 80–160 square kilometres in FutureGen's site.
House and his C12 colleagues are taking a broader approach, seeking legal access to all of the pore space in their reservoir. So far, C12 has signed leases with nearly 200 landowners, covering roughly 60% of the 100 square kilometres in their field, an area that could store roughly 13 times more CO_2 than FutureGen expects to capture. Meanwhile, the company is working with Illinois lawmakers on extending to carbon storage the laws that apply to oil and gas fields, which grant legal access to the entire area once a certain percentage of the owners involved have signed on.

Some say that C12's business model simply didn't fit into the FutureGen project. James Wood, deputy assistant secretary for clean coal programmes at the Department of Energy, says that handing the storage half of the FutureGen project over to a commercial entity such as C12 might undercut the mission of the FutureGen Alliance partners, who are bolstering the more than $1 billion in public money with roughly $244 million of their own. "We don't want anybody skipping out halfway through the project," Wood says.
But for Schrag, that's further evidence that FutureGen is not being run the way it should be, which is as a commercial venture. He fears that FutureGen's current course could inflate costs and ultimately set the industry back. "This is the government's flagship demonstration of carbon capture and sequestration," Schrag says. "We really need it to work."

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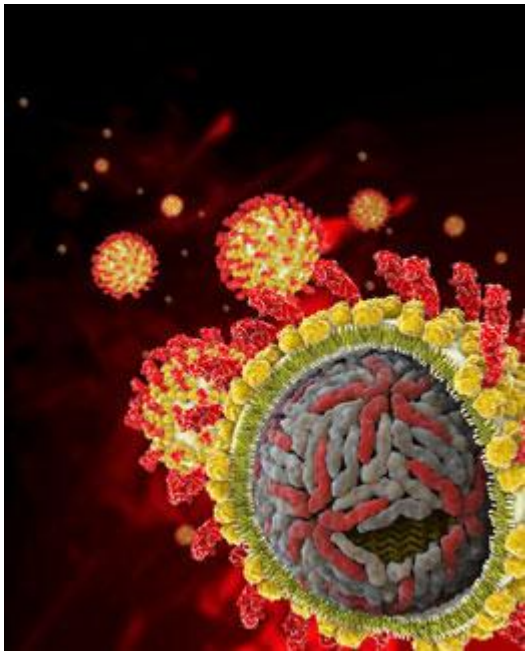
New drug targets raise hopes for hepatitis C cure

As the first targeted therapies edge towards regulatory approval, attention turns to the next drugs in line.
Heidi Ledford



A cocktail of tailored drugs will be needed to defeat the hepatitis C virus.Ramon Andrade 3Dciencia / Science Photo Library

Later this week, a panel of advisers to the US Food and Drug Administration (FDA) will decide whether the regulator should approve the first therapies tailored to target the hepatitis C virus (HCV). The drugs, called protease inhibitors, are expected to win approval, but observers say that they are only the beginning of a revolution in HCV treatment.

The most exciting developments for patients, they say, may still be in the drug-development pipeline. Researchers are working on drugs that target many aspects of the virus's biology. Used in combination, these might thwart HCV's ability to evolve resistance.

About 3% of the world's population is infected with HCV, an RNA virus that can cause chronic liver disease. Current therapy — a year-long regimen of the antiviral compounds interferon-alpha and ribavirin — cures only about half of cases. Side effects of this treatment can be severe: interferon-alpha can cause flu-like symptoms, fatigue, anaemia and depression.

On 27 and 28 April, the FDA's Antiviral Drugs Advisory Committee will meet to discuss the first anti-HCV drugs to target HCV proteins. Both these drugs — boceprevir, made by pharmaceutical giant Merck, headquartered in Whitehouse Station, New Jersey, and telaprevir from Vertex Pharmaceuticals, based in Cambridge, Massachusetts — target a protein called the NS3-4A protease, which is required to make essential viral proteins.

Each drug, when combined with standard therapy, boosts the cure rate to about 75%.

"I am very excited," says Michael Houghton, a virologist at the University of Alberta in Edmonton, who was a member of the team that discovered the virus in 1989. "These drugs are great news for HCV patients."

The long road to a blockbuster

Nevertheless, these drugs are only the beginning. "These first-generation protease inhibitors will enjoy their day in the sun for maybe two or three years," says Raymond Chung, head of hepatology at the Massachusetts General Hospital in Boston. "But I don't see them having staying power once we have many more of these targeted drugs getting into the game."

The hope is to eventually use several drugs in combination, avoiding the need for interferon-alpha while staving off drug resistance. Houghton estimates, based on mathematical models and clinical studies, that it will take a cocktail of three targeted therapies to prevent drug resistance.
There are about 60 compounds in preclinical and clinical development as companies jostle to grab a slice of a multi-billion-dollar market.
In 2010, researchers at Bristol-Myers-Squibb's lab in Wallingford, Connecticut, reported their discovery of an HCV protein called NS5A that is essential for the assembly of infectious viral particles and the amplification of viral RNA[1]. In early clinical trials of an NS5A inhibitor, the level of HCV RNA in the blood dropped almost 2,000-fold after only one day of treatment. This drug is now in phase 2 clinical trials.
Combining the NS5A inhibitor with a protease inhibitor wiped out the virus in four of 11 patients whose infections had not responded to standard therapy. The virus remained undetectable for at least 24 weeks.
These latest results, presented at the International Liver Congress annual meeting in Berlin on 1 April, are exciting because they suggest that interferon may eventually be dispensable, says Chung. He anticipates a flurry of such combination studies in the next few years.

Access denied

Another approach is to stop HCV spreading inside patients by targeting its ability to enter cells. "To contain the virus in a subset of cells rather than allowing it to spread would be a huge boost for containing liver damage," says Michael Gale, a virologist at the University of Washington in Seattle.
In a study published in Nature Medicine on 24 April, a team led by virologist Thomas Baumert of the University of Strasbourg, France, reports that HCV relies on a cellular receptor protein, the epidermal growth factor receptor (EGFR), to enter human cells[2]. EGFR inhibitors are already on the market as cancer therapies and Baumert's team plans to begin clinical trials of the EGFR inhibitor erlotinib in HCV patients by the end of the year.
Another drug that blocks entry, ITX-5061, is being developed by iTherX, a pharmaceutical company based in San Diego, California, and is in phase 2 clinical trials.
Chung, meanwhile, believes that drugs called nucleoside polymerase inhibitors, which prevent the virus from copying its genome, will be a key ingredient of any future HCV drug cocktail. These compounds set a high barrier for the virus, he notes, and early tests suggest that resistance to them is rare.
Pharmasset, a pharmaceutical firm in Princeton, New Jersey, has several such drugs in development. One called RG7128 is in phase 2 clinical trials and is being developed by Pharmasset together with the Swiss drug giant Roche, based in Basel.
"We used to live in a monochromatic world," says Chung. "Now we realize there are several roads to the same destination."

- **References**

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2. Lupberger, J. et al. Nature Med. doi:10.1038/nm.2341 (2011).

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