

Can blocking a frown keep bad feelings at bay?

Your facial expression may tell the world what you are thinking or feeling. But it also affects your ability to understand written language related to emotions, according to research published in the July issue of *Psychological Science*, a journal of the Association for Psychological Science.

The new study reported on 40 people who were treated with botulinum toxin, or Botox. Tiny applications of this powerful nerve poison were used to deactivate muscles in the forehead that cause frowning.

The interactions of facial expression, thoughts, and emotions have intrigued scientists for more than a century, says the study's first author, University of Wisconsin-Madison psychology Ph.D. candidate David Havas.

Scientists have found that blocking the ability to move the body causes changes in cognition and emotion, but there were always questions. (One of the test treatments caused widespread, if temporary, paralysis.) In contrast, Havas was studying people after a pinpoint treatment to paralyze a single pair of "corrugator" muscles, which cause brow-wrinkling frowns.

To test how blocking a frown might affect comprehension of language related to emotions, Havas asked the patients to read written statements, before and then two weeks after the Botox treatment. The statements were angry ("The pushy telemarketer won't let you return to your dinner"), sad ("You open your e-mail in-box on your birthday to find no new e-mails") or happy ("The water park is refreshing on the hot summer day.").

Havas gauged the ability to understand these sentences according to how quickly the subject pressed a button to indicate they had finished reading it. "We periodically checked that the readers were understanding the sentences, not just pressing the button," says Havas.

The results showed no change in the time needed to understand the happy sentences. But after Botox treatment, the subjects took more time to read the angry and sad sentences. Although the time difference was small, it was significant, he adds. Moreover, the changes in reading time couldn't be attributed to changes in participants' mood.

The use of Botox to test how making facial expressions affect emotional centers in the brain was pioneered by Andreas Hennenlotter of the Max Planck Institute in Leipzig, Germany.

"There is a long-standing idea in psychology called the facial feedback hypothesis," says Havas. "Essentially, it says, when you're smiling, the whole world smiles with you. It's an old song, but it's right. Actually, this study suggests the opposite: When you're not frowning, the world seems less angry and less sad."

The Havas study broke new ground by linking the expression of emotion to the ability to understand language, says Havas' adviser, UW-Madison professor emeritus of psychology Arthur Glenberg. "Normally, the brain would be sending signals to the periphery to frown, and the extent of the frown would be sent back to the brain. But here, that loop is disrupted, and the intensity of the emotion and of our ability to understand it when embodied in language is disrupted."

Practically, the study "may have profound implications for the cosmetic-surgery," says Glenberg. "Even though it's a small effect, in conversation, people respond to fast, subtle cues about each other's understanding, intention and empathy. If you are slightly slower reacting as I tell you about something made me really angry, that could signal to me that you did not pick up my message."

Such an effect could snowball, Havas says, but the outcome could also be positive: "Maybe if I am not picking up sad, angry cues in the environment that will make me happier."

In theoretical terms, the finding supports a psychological hypothesis called "embodied cognition," says Glenberg, now a professor of psychology at Arizona State University. "The idea of embodied cognition is that all our cognitive processes, even those that have been thought of as very abstract, are actually rooted in basic bodily processes of perception, action and emotion."

With some roots in evolutionary theory, the embodied cognition hypothesis suggests that our thought processes, like our emotions, are refined through evolution to support survival and reproduction.

Embodied cognition links two seemingly separate mental functions, Glenberg says. "It's been speculated at least since Darwin that the peripheral expression of emotion is a part of the emotion. An important role of emotion is social: It communicates 'I love you' or 'I hate you,' and it makes sense that there would be this very tight connection between peripheral expression and brain mechanism."

"Language has traditionally been seen as a very high-level, abstract process that is divorced from more primitive processes like action, perception and emotion," Havas says. "This study shows that far from being divorced from emotion, language understanding can be hindered when those peripheral bodily mechanism are interrupted." *For more information on this study please contact: David Havas dahavas@wisc.edu*

MDMA (Ecstasy)-assisted psychotherapy relieves treatment-resistant PTSD ***First completed clinical trial results out today in the Journal of Psychopharmacology***

London, UK (July 19, 2010) – MDMA (\pm 3,4-methylenedioxymethamphetamine, also known as Ecstasy), may one day offer hope for individuals with posttraumatic stress disorder (PTSD), even people for whom other treatments have failed. Clinical trial results out today in the *Journal of Psychopharmacology*, published by SAGE, suggests that MDMA can be administered to subjects with PTSD without evidence of harm and could offer sufferers a vital window with reduced fear responses where psychotherapy can take effect.

Before MDMA became used recreationally under the street name Ecstasy, hundreds of psychiatrists and psychotherapists around the world administered MDMA as a catalyst to psychotherapy. MDMA was criminalized in the US in 1985 (it had been illegal in the UK since 1977). Several decades later, this study is the first completed randomised, double-blinded clinical trial to evaluate MDMA as a therapeutic adjunct in any patient population.

Belmont, MA-based Rick Doblin, Ph.D., President of the Multidisciplinary Association for Psychedelic Studies (www.maps.org, a non-profit psychedelic and medical marijuana research and educational organization that sponsored the study), together with South Carolina-based psychiatrist Michael Mithoefer, MD and colleagues, conducted a pilot Phase II clinical trial with 20 patients with chronic PTSD persisting for an average of over 19 years. Prior to enrolling in the MDMA study, subjects were required to have received, and failed to obtain relief, from both psychotherapy and psychopharmacology.

Participants treated with a combination of MDMA and psychotherapy saw clinically and statistically significant improvements in their PTSD – over 80% of the trial group no longer met the diagnostic criteria for PTSD, stipulated in the Diagnostic and Statistical Manual of Mental Disorders IV (DSM-IV-TR) following the trial, compared to only 25% of the placebo group. In addition, all three subjects who reported being unable to work due to PTSD were able to return to work following treatment with MDMA.

The trial centred on two eight-hour psychotherapy sessions scheduled about 3-5 weeks apart, where 12 subjects received MDMA, and eight took a placebo. Subjects were also given psychotherapy on a weekly basis before and after each experimental session. A blinded, independent rater tested each subject using a PTSD scale at baseline, and at intervals four days after each session and two months after the second session. The clinical response was significant – 10 of the 12 in the treatment group responded to the treatment compared with just two of the eight in the placebo group. During the trial, the subjects did not experience any drug-related Serious Adverse Events (SAEs), nor any adverse neurocognitive effects or clinically significant blood pressure or temperature increases.

After the two-month follow-up, subjects in the placebo group were offered the option to participate in the treatment process again, to receive MDMA on an open-label basis, acting as their own controls. Seven of the eight placebo subjects elected to receive MDMA-assisted psychotherapy, with successful treatment outcomes similar to the subjects initially randomized to MDMA.

PTSD involves exaggerated and uncontrolled fear responses. To treat these, psychotherapists need to help sufferers revisit traumatic experiences. But patients often suffer intolerable feelings when they revisit the trauma, or numb themselves emotionally, resulting in the psychotherapy having little effect. The goal of using MDMA is to temporarily reduce fear and increase trust without inhibiting emotions, especially painful emotions, allowing these patients a window where psychotherapy for their PTSD is effective.

MDMA's pharmacological effects include serotonin release, 5HT₂ receptor stimulation and increase in levels of the neurohormones oxytocin, prolactin and cortisol.

Importantly, this trial involved concentrated periods of patient-therapist contact (31 hours over two months) including two all-day therapy sessions and overnight stays in the clinic. "These are not usual features of psychotherapy practice in the outpatient setting," says Michael Mithoefer. MDMA-assisted psychotherapy would require special clinics equipped for longer treatment sessions and overnight stays if an MDMA-based treatment were approved. "This method also involves patient preparation and close follow-up to support further processing of emotions and integration of cognitive shifts that may occur," Mithoefer adds, stressing that these are vital for safety and therapeutic effect.

Measures like these may prove a price worth paying, however, to alleviate the debilitating effects of PTSD on sufferers in future.

The authors caution that the study does have limitations – for example they did not look at gender and ethnic factors in their sample selection. Another important limitation was that most participants and trial investigators guessed accurately whether they were in the treatment or the placebo group. The placebo had no psychoactive effect and investigators could detect raised blood pressure and other symptoms in the MDMA group. A long-

term follow-up to the study just published, evaluating subjects an average of about 40 months post-treatment, is underway.

The investigators have now received the go ahead from the US Food and Drug Administration (FDA) for a protocol for a three-arm, dose-response design that they expect will result in successful blinding. This new study is for US veterans with war-related PTSD, most from Iraq and Afghanistan and a few from Vietnam. MAPS is currently sponsoring MDMA/PTSD Phase 2 pilot studies in Switzerland and Israel, and is working to start additional pilot studies in Canada, Jordan and Spain.

The safety and efficacy of \pm 3,4-methylenedioxymethamphetamine -assisted psychotherapy in subjects with chronic treatment-resistant posttraumatic stress disorder: the first randomised controlled pilot study by Michael C. Mithoefer, M.D., Mark T. Wagner, Ph.D., Ann T. Mithoefer, B.S.N., Lisa Jerome, Ph.D., and Rick Doblin, Ph.D. is published today (19th July 2010) in the Journal of Psychopharmacology.

Microbicide trial results a turning point for HIV prevention, says team testing same gel CAPRISA 004 finds tenofovir gel used before and after sex reduced HIV by 39 percent in women; daily gel use being tested in VOICE

Researchers who conducted a study testing a vaginal microbicide with an antiretroviral (ARV) drug called tenofovir found its use before and after sex was significantly more protective against HIV infection than a placebo gel among women at high risk of HIV. Results of the study, known as CAPRISA 004, are to be reported at the International AIDS Conference (AIDS 2010) in Vienna and published online by the journal Science.

CAPRISA 004 involved 889 women from Durban and a nearby rural community in South Africa, where women are at especially high risk of acquiring HIV through sexual intercourse. Women were randomly assigned to one of two study groups – tenofovir gel or placebo gel with no active ingredient –and instructed to use the study product in a regimen timed before and after sex. At the end of the study, there were 39 percent fewer HIV infections among women who used tenofovir gel before and after sex than among those who used the placebo gel. The study was conducted by the Centre for the AIDS Programme of Research in South Africa (CAPRISA).

"This study has established proof of concept that a vaginal microbicide containing an ARV can protect women from HIV. This is an incredibly important achievement for which the CAPRISA team is to be congratulated. For all of us in the HIV prevention field, this result has shown that it may be possible to leverage this initial success using a single ARV at the time of sex into more potent approaches that could be 50, 60 or even 70 percent effective for prevention of HIV. The results of this study have reinvigorated the field," commented Sharon Hillier, Ph.D., professor and vice chair for faculty affairs, and director of reproductive infectious disease research in the department of obstetrics, gynecology and reproductive sciences at the University of Pittsburgh School of Medicine, and principal investigator of the Microbicide Trials Network (MTN).

The MTN currently is conducting another study called VOICE – Vaginal and Oral Interventions to Control the Epidemic – that will provide evidence about the safety and efficacy of tenofovir gel used daily, regardless of when participants have sex. VOICE, sometimes referred to as MTN-003, also is evaluating another promising approach called oral pre-exposure prophylaxis (PrEP), which involves daily use of an ARV tablet (tenofovir or Truvada[®]). VOICE is the first HIV prevention trial testing two different approaches in the same study and the first effectiveness trial of a microbicide in which women use the gel every day instead of only around the time of sex. The study plans to enroll about 5,000 women at sites in South Africa, Uganda, Zimbabwe and Malawi. Nearly 1,000 women have been enrolled so far.

Tenofovir gel and the tablets being tested in VOICE and other PrEP trials incorporate some of the same ARV medicines used successfully for treatment of HIV. The hope is that they will also be safe and effective for HIV prevention.

"CAPRISA's contribution to our understanding of how topically applied ARVs could prevent HIV is extraordinary. The results of this study bode well for the future of microbicide research and for investigation of ARV-based prevention for men and women worldwide. And as the first completed effectiveness study involving ARVs for prevention, CAPRISA 004 raises the bar for VOICE. I would argue that VOICE is more relevant than ever. We're now in a position where we may learn that daily use of tenofovir gel is equally safe and could possibly be even more effective than the regimen tested in CAPRISA 004," commented MTN Co-Principal Investigator Ian McGowan, M.D., Ph.D., FRCP, professor of medicine in the division of gastroenterology, hepatology and nutrition with a joint appointment in the department of obstetrics, gynecology and reproductive sciences at the University of Pittsburgh School of Medicine.

"It is gratifying that we are a step closer to identifying a safe and effective HIV prevention method for women. But to know for certain that tenofovir gel is effective, additional studies must be performed, because

we can't be sure that what worked for the women in CAPRISA 004 will be the same for women elsewhere," said Mike Chirenje, M.D., FRCOG, associate professor and consultant gynecologist in the department of obstetrics and gynecology at the University of Zimbabwe in Harare and co-chair of the VOICE Study. "VOICE hopes to answer some of the questions about tenofovir gel – and oral PrEP – that CAPRISA 004 was not designed to address."

"Both studies are about finding safe, effective choices for women, whether that choice is a gel used with sex or a gel or tablet used every day," added Jeanne Marrazzo, M.D., M.P.H., VOICE Study co-chair, and professor of medicine in the division of allergy and infectious diseases at the University of Washington in Seattle.

"Some women may prefer to use a product only when they have sex; others may prefer – or require – protection more often. CAPRISA 004 and VOICE are complementary studies that together can give us a substantial amount of information about these approaches. That's important, because we have to be certain that the evidence base for any approach is rock solid before that intervention should be made available more broadly to women at risk for HIV."

VOICE is funded by the by the Division of AIDS (DAIDS) at the National Institute of Allergy and Infectious Diseases with co-funding from the National Institute of Mental Health and the Eunice Kennedy Shriver National Institute of Child Health and Human Development, all components of the U.S. National Institutes of Health (NIH).

Women represent nearly 60 percent of adults living with HIV in sub-Saharan Africa, and in several southern African countries young women are at least three times more likely to be HIV-positive than young men. In most cases, women acquire HIV through sexual intercourse with an infected male partner.

Although correct and consistent use of male condoms has been shown to prevent HIV infection, women often cannot control if or when condoms are used by their male partners. Moreover, women are twice as likely as their male partners to acquire HIV during unprotected sex, due in part to biological factors that make them more susceptible to infection.

What protects farm children from hay fever: The protective substance slumbers in cowshed dust

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RUB researchers publish their findings in the Journal of Allergy and Clinical Immunology

Researchers from Bochum have isolated the substance in cowshed dust that possibly protects farm children from developing allergies and allergic asthma, namely the plant sugar molecule arabinogalactan. If high concentrations thereof are inhaled during the first year of life it inhibits the immune system from excessive defense reactions. There are large quantities of this molecule in forage crops such as the Meadow Foxtail (*Alopecurus pratensis*). The researchers from Bochum, Munich and Borstel, working the under the auspices of Dr. Marcus Peters (Department of Experimental Pneumology at the RUB, Prof. Dr. Albrecht Bufe), were able to demonstrate experimentally that the molecule affects immune system cells. They have reported their findings in the current edition of the Journal of Allergy and Clinical Immunology.

The needle in the haystack

It has long been known that children who grow up on farms are less prone to allergies and allergic asthma. However, just what it is that protects them remained a riddle for a long time. Dr. Marcus Peters stated that finding the protective substance was like looking for the proverbial needle in the haystack. He could make use of stable dust collected from diverse farms in Germany, Austria, and Switzerland, an analysis of which disclosed that it is primarily comprised of plant substances. Over ten percent thereof is arabinogalactan, a large sugar molecule, thus it was classified as "suspicious."

Prevent excessive alertness of the immune system

The researchers thus tested the reaction of the immune system of mice to potential allergens if arabinogalactan molecules are present. Dr. Peters stated that they found that the dendritic cells, which introduce damaging invaders to the immune cells and cause them to react, change their behaviour if arabinogalactan is present. They then produce a specific transmitter that suppresses the immune reaction. It remains to be clarified which receptors of the dendritic cells are responsible for this mechanism. Sugar receptors are generally important for the immune system to help it to identify foreign particles. Dr. Peters explained that this suppression of the immune system was not new to them. Some bacteria also make targeted use of this mechanism to reduce the immunoreaction of the host. Arabinogalactan does however only prevent the excessive alertness of the immune system – the resistance to pathogenic agents continues to function normally.

It depends on the dose

The researchers were not surprised that a grass component - of all things - protects children against hay fever. Dr. Marcus Peters stated that it is all a question of the concentration. Low concentrations of Meadow Foxtail pollen can lead to allergies, whereas high doses in the very early stages of life can also prevent them. After all, hyposensitization is also based on the principle of increasing the dose. The scientists now plan to investigate whether arabinogalactan can be used as prophylaxis or whether it is also suitable for the treatment of

allergies and allergic asthma. It is conceivable that arabinogalactan could be used as spray or nose drops because it is highly water-soluble.

* Full bibliographic information Marcus Peters, Marion Kauth, Olaf Scherner, Kirsten Gehlhar, Imke Steffen, Pia Wentker, Erika von Mutius, Otto Holst, Albrecht Bufer: Arabinogalactan isolated from cowshed dust extract protects mice from allergic airway inflammation and sensitization. In: *Journal of Allergy and Clinical Immunology*. DOI: 10.1016/j.jaci.2010.05.011

Lake Superior, a Natural Global Warming Gauge, Is Running a Fever

This year, the waters in Lake Superior are on track to reach-and potentially exceed-the lake's record-high temperature of 68 degrees Fahrenheit

By Dina Fine Maron and Climatewire

The Great Lakes are feeling the heat from climate change.

As the world's largest freshwater system warms, it is poised to systematically alter life for local wildlife and the tribes that depend on it, according to regional experts. And the warming could also provide a glimpse of what is happening on a more global level, they say.

"The Great Lakes in a lot of ways have always been a canary in the coal mine," Cameron Davis, the senior adviser to the U.S. EPA on the Great Lakes, said last week. "Not just for the region or this country, but for the rest of the world." And it seems the canary's song is growing ever more halting.

Lake Superior, which is the largest, deepest and coldest of the five lakes, is serving as the "canary for the canary," Davis said at a public meeting of the Interagency Climate Change Adaptation Task Force last week, pointing to recent data trends. Total ice cover on the lake has shrunk by about 20 percent over the past 37 years, he said. Though the change has made for longer, warmer summers, it's a problem because ice is crucial for keeping water from evaporating and it regulates the natural cycles of the Great Lakes.

But the warming shows no sign of abatement. This year, the waters in Lake Superior are on track to reach - and potentially exceed - the lake's record-high temperatures of 68 degrees Fahrenheit, which occurred in 1998.

Analysis of several buoys that measure temperatures in the lake reveal that the waters are some 15 degrees warmer than they would normally be at this time of year, Jay Austin, a professor of physics at the University of Minnesota, Duluth's Large Lakes Observatory, said in a recent interview.

His analysis of National Oceanic and Atmospheric Administration data indicates that summer for the lake, which happens at about a 40-degree threshold, came about a month early this year.

A 'tremendously anomalous' year

"This year is just tremendously anomalous," he said. "This year ranks up there with the warmest water we have ever seen, and the warming trend appears to be going on in all of the Great Lakes."

While the warmer waters make for more comfortable swimming conditions for humans, they may also make for more habitable conditions for invasive species in places that have previously been relatively free of such pests.

Exhibit one, said James Kitchell, a professor of zoology at the University of Wisconsin, Madison's Center for Limnology, is the blood-sucking sea lamprey.

The jawless parasite attaches itself to the side of trout, bores a hole and sucks the trout's blood, growing to as long as 3 feet in the process, according to Kitchell. But in warmer weather, the lamprey may feed faster, grow bigger and lay more eggs, he said. The creatures will also become adults faster and require more frequent extermination, thanks to the warmer waters, warned Marc Gaden, a spokesman for the Great Lakes Fishery Commission, in an interview.

Meanwhile, the dead trout, with gaping holes in their sides, will sink to the seafloor below - far from where humans can witness the evidence.

But the full impact of decades of water warming is not bound to the murky depths.

The warming may also threaten practices that are central to the "cultural identity" of indigenous tribes that live in the Great Lakes area and depend on certain weather and water conditions to farm wild rice, according to Nancy Schuldt, the water quality coordinator of the Fond du Lac Band of Chippewa Indians.

The Fond du Lac Band lives on a 101,000-acre reservation in northeast Minnesota about 20 miles inland from Lake Superior in the far western corner of the lake.

Low water levels may mean it's not safe to get canoes into the waters and hand-harvest rice in the traditional manner, she said, pointing to a rice operation by the Bad River Band of Lake Superior Chippewa that had to shut down in 2007 after drought made it too difficult to maneuver canoes. The rice itself is at risk of being phased out by other native species, she said, noting that the rice is "very sensitive to hydrologic changes."

Though tribes in this area are doing what they can to invest in clean energy and study local water temperature trends to help plan future adaptation strategies, "there's still really fundamental questions remaining" about what the future environment will look like, she said.

A 'cultural identity' at risk of being transformed

"Will there still be wild rice? Will there still be birch bark to harvest? Will there still be a sugar bush?" she asked. "Right now, we certainly don't have those answers."

While there is a certain amount of uncertainty in predicting climate change impacts, the various models forecast that the Great Lakes region may see lower lake levels "on the order of 1 to 2 feet, said EPA's Davis.

In February, the Obama administration rolled out a five-year Great Lakes Action plan dedicated to adapting to some of these effects and restoring the area.

The plan, which would cost more than \$2 billion to carry out, lays out five central goals it hopes to address in the coming years: restoring lost wetlands, controlling invasive species, tackling runoff pollution, addressing toxics like mercury, and promoting accountability and education efforts.

As water levels decline, toxics need to get cleaned up, and "fast," said Davis. "The reason is that with climate change scenarios starting to kick in, we have to get those areas cleaned up so we aren't unwittingly circulating more contaminants than we need to," he said.

To adapt to the warmer temperatures, "The most important thing we can do is to use the best science in all the initiatives that are under way," added Andy Buchsbaum, the Great Lakes regional executive director of the National Wildlife Federation.

"Don't just look at the way things are now, but the way they are likely to be in the coming years, and use all the resources we have now in the service of preparing for climate change," he said.

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Numberplay: Rare Coincidences Are Very Common!

By PRADEEP MUTALIK

"Wow!" "Amazing!" "Unbelievable!" "What are the chances of that?" Most, if not all of you, have uttered words like this at some time in your life. The paradoxical title of today's Numberplay, then, is true: rare coincidences are really common.

Why should this be? After all, rare should be rare, shouldn't it? People who are prone to magical thinking seize on such commonly experienced rare coincidences and ascribe cosmic significance to them, invoking Divine Providence or Pre-arranged Destiny or Synchronicity or some other favored pseudoscientific explanation. But if these coincidences are so common as to happen to everyone, then how significant can they be? It's like that pearl of wisdom that I first heard from a treasured friend, The Talking Moose, on an old Mac computer over 20 years ago: "Remember that you are a unique individual - just like everyone else."

Today, we'll see how the commonness of rare coincidences can be fully explained by nothing more than an interaction of mathematics and human psychology, creating a few distinct patterns of fallacious thinking, which I'll give as label and problem.1 The first one is Too Many Targets.

1. Suppose there are a thousand possible rare events, each of which can happen with the "unbelievable" probability of one in a million on a particular day. How likely is it that you will encounter one such unbelievable event in a year? In a lifetime of 80 years? How many such events will an average person see in his or her 80-year lifespan?

In fact, the number of possible events that we would consider "rare" are much much more than a thousand. There are so many of them that it would be fruitless to try and list all of them before they happen, and so we don't think about them. We just reserve our oohs and aahs for the ones that do happen. Gary's graphic says it all. You throw a dart at random on to a dark wall, and shine a flashlight to see where it went. Wow, it hit a bull's eye! Amazing! Very few of us bother to turn on the light switch. The flashlight of our selective attention blinds us to the underlying reality. It turns out that the whole wall is tiled with bull's eyes! Moreover, throughout your life you take thousands of potshots at them.

In his book "Unweaving the Rainbow" Richard Dawkins coined a technical term for the target-studded wall of potential coincidences. He calls it a PETWHAC - "Population of Events That Would Have Appeared Coincidental." In most circumstances, the PETWHAC is huge. After all, in today's Age of Information age we are bombarded every day with thousands of facts, names and numbers that can become fodder for coincidence.

Sometimes you don't find coincidence, coincidence finds you. This brings us to our second label. It's called You Are The Chosen.

2. Imagine that you are following a series of eight important ballgames. The day before each ballgame, you receive an e-mail accurately naming the team that is going to win. It's uncanny! The e-mail admits that similar predictions have been sent out to other people, but that each prediction is "personalized" and is solely dependent on the receiver's psychic persona. Believing that you are attracting good luck, you willingly part with a small amount of money, say \$10, to be tipped off about the next game. After all, you stand to win a lot more with the bookmakers. Assuming the games are fair with each team equally likely to win, and the

scammers are guessing too, how could such a scam be carried out? How many people will they have to e-mail to earn \$500 on the ninth game if half of the eligible people fall for the bait? How many more games on average after the eighth before the e-mail oracle fails?

3. The above problem had a real world counterpart in the recent World Cup. An octopus named Paul correctly predicted the results of each of the eight games that Germany played. What do you think is the most likely explanation for Paul's success?

There are many other fallacious reasons why coincidences seem so common. Among them are Overestimating the Odds, Making A Good Story, Parallel Thinking, In-Step Emotional Time Constants, Subconscious Cues, Publicity Seeking and of course, the age-old favorite – There's A Sucker Born Every Minute. I won't dilate on them here, but you can try and guess what they might be. If this topic is a hit, I may give you more puzzles based on it next time.

I'd love to hear about examples of coincidences in your own experience and the possible or real reasons for them. You can also try to come up with oxymorons such as the title of today's Numberplay and the sage utterance of the Talking Moose.

In parting, I'd like to put forth what I think the proper emotional attitude to such coincidences should be. Do rational explanations of coincidences take the magic out of life? Do they, in fact, "unweave the rainbow," as the poet Keats accused the scientist Newton of doing, in a diatribe that inspired the title of Dawkins's book? Not at all! If you are anything like me, you have been as moved and have shed as many tears watching and reading fictitious stories as you have in real life, even though you knew that the stories weren't true. Enjoying the wonder of something has nothing to do with intellectually believing that it is true or cosmically significant.

So I say, let's enjoy the coincidences that come our way. It's an emotional response that's wired into our brains, a throwback to the times when we lived in small groups and encountered only a small fraction of the information we do today. Be liberal with "Wow!" and "Amazing!" and "Unbelievable!" Enjoy them to the fullest. Just don't take the coincidences seriously. They usually mean absolutely nothing.

May your coming week be blessed with many interesting coincidences. And may you not assign cosmic significance to them. *1. That's my version of "chapter and verse."*

Polio: Setbacks in a Mostly Successful Fight to Eliminate a Paralyzing Disease

By DONALD G. McNEIL Jr.

The battle to eliminate polio, which has been more than 99 percent successful and has hovered on the verge of victory for a decade, has sustained new setbacks.

There has been an outbreak of more than 300 cases in Tajikistan this year. (Tajikistan is just north of Afghanistan, and fighting on the Afghan-Pakistan border between the United States and the Taliban has let the disease surge in both countries.) Cases in the two permanent hot spots, Nigeria and India, are down but not eliminated, and the two continue to seed outbreaks in neighboring countries.

But the "biggest bump in the road," Dr. John F. Modlin, a polio expert at Dartmouth Medical School wrote in a recent article in *The New England Journal of Medicine*, has been the recent emergence of polio cases caused by live vaccine viruses that mutated until they, too, were dangerous enough to cause paralysis. The problem was first discovered in the Dominican Republic and Haiti a decade ago; that outbreak was quelled. But since last year, it has happened in Nigeria, Congo, Somalia, India and Ethiopia. Case numbers are tiny, but the idea of vaccine leading to disease could scare people away from being vaccinated.

The vaccine drops themselves are safe, but the live virus they contain then circulates, protecting more people - unless dangerous mutations occur. Because killed vaccines are expensive to make and to inject, the only practical solution for now is more aggressive oral vaccination, experts say.

Risks: Depression Linked to Later Dementia

By RONI CARYN RABIN

A new study suggests that people with depression are significantly more likely to develop dementia later in life.

The analysis, published July 6 in the journal *Neurology*, followed 949 participants in the famous Framingham Heart Study over an average of eight and a half years, some for as long as 17 years.

In that time, more than 17 percent - 164 participants - developed dementia. But among those who were depressed when the study started, the rate was much higher: almost 22 percent.

Adjusting for differences between groups, researchers found that depression raised the risk of dementia by 72 percent. And the more severe the depression, the greater the risk of dementia later.

The lead author, Dr. Jane Saczynski, an assistant professor at the University of Massachusetts Medical School in Worcester, suggested that the vascular changes in the brain associated with depression might also lead to dementia. Given the study's long interval, she said, "it is very clear that depression is a risk factor for dementia rather than a consequence of the disease."

With This Rinse, Performance Improves

By GINA KOLATA

Exercise scientists say they have stumbled on an amazing discovery. Athletes can improve their performance in intense bouts of exercise, lasting an hour or so, if they merely rinse their mouths with a carbohydrate solution. They don't even have to swallow it. It has to be real carbohydrates, though; the scientists used a solution of water and a flavorless starch derivative called maltodextrin. Artificial sweeteners have no effect.

And the scientists think they have figured out why it works. It appears that the brain can sense carbohydrates in the mouth, even tasteless ones. The sensors are different from the ones for sweetness, and they prompt the brain to respond, spurring on the athlete.

Many athletes depend on sugary beverages to keep them going. But often, when blood is diverted from the stomach to working muscles during intense exercise, drinks or foods cause stomach cramps. So a carbohydrate rinse can be a way to get the same effect. "You can get an advantage from tricking your brain," said a discoverer of the effect, Matt Bridge, a senior lecturer in coaching and sports science at the University of Birmingham in England. "Your brain tells your body, 'Carbohydrates are on the way.'" And with that message, muscles and nerves are prompted to work harder and longer.

It's a relatively small effect, said George A. Brooks, an exercise researcher at the University of California, Berkeley, who was not involved with the research. But a small difference, he added, "can make a big difference in competition."

The discovery began with some puzzling findings dating to the 1990s. Until then, exercise scientists thought they knew why it could help to eat or drink carbohydrates during a long endurance event like a marathon. Muscles can use up their glycogen, the storage form of glucose, during long exercise sessions. But if athletes consume carbohydrates, they can provide a new source of fuel for their starving muscles.

That theory predicts that carbohydrates should have no effect on performance in shorter races, an hour or less. Muscles can't use up their glycogen that fast, and by the time the body metabolizes the carbohydrates for fuel, the race is almost over.

Then came a handful of studies showing that carbohydrates did have an effect in short exercise sessions. Athletes, often trained cyclists, rode hard and fast for an hour or so after drinking either a beverage containing carbohydrates or one that tasted the same but contained an artificial sweetener.

In intense exercise sessions lasting more than half an hour, the athletes were able to go faster or keep going longer when they had the drink with carbohydrates. Their performance improved as much as 14 percent.

Some studies, though, did not find an effect. And the difference seemed to be that athletes who were hungry showed improved performance.

It made no sense. Could the body somehow have metabolized the carbohydrates in the drinks and put them to use in such a short time? Did the muscles even need carbohydrates in such short bouts of exercise?

Asker Jeukendrup, an exercise physiologist at the University of Birmingham, and his colleagues put that idea to the test. They were among the first researchers to discover a carbohydrate effect in cyclists riding hard for an hour, and they had been puzzling over what could account for it.

So they gave trained cyclists intravenous infusions of glucose or, as a control, intravenous salt water, before asking them to ride as fast as they could for about 24 miles, about an hour. The intravenous glucose meant the athletes had large amounts of sugar available right away - no digestion required. But it had no effect on their performance.

Next they tried what seemed like a crazy idea. They asked the cyclists to do the same ride, but first to rinse their mouths with the maltodextrin solution (or, as a control, with water). "The results were remarkable," the researchers wrote. Just rinsing with a carbohydrate had the same effect as drinking it.

Other scientists repeated the experiment. One group used runners, asking them to run for 30 minutes or, in another study, 60 minutes. Rinsing the mouth with carbohydrates consistently led them to run farther, as compared with rinsing with placebos.

Dr. Jeukendrup and his colleagues continued to tweak the study conditions. What happened, they asked, if athletes ate breakfast before rinsing with carbohydrates, or drinking a carbohydrate solution? Then, they found, carbohydrates had no effect.

Meanwhile, neuroscientists found that rodent brains, at least, responded to carbohydrates in the mouth independently of their response to sweetness. It is carbohydrates that matter, and so artificial sweeteners do not stimulate these pathways that go from the mouth to the brain.

Then Dr. Bridge and his colleagues in Birmingham used functional magnetic-resonance imaging to determine whether glucose, which tastes sweet, has the same effect on the brain as the tasteless carbohydrate maltodextrin. They also tested artificial sweeteners for comparison. The brain scan results confirmed the

exercise study results: Carbohydrates activated brain areas involved with rewards and muscle activity. Artificial sweeteners did not.

Is rinsing worthwhile for most athletes? Scott J. Montain, an exercise researcher at the United States Army Research Institute of Environmental Medicine, thinks not. The effect is real, he said, but added, "Endurance competitors are better off just consuming the calories." That way they get real fuel, instead of "sipping and then spitting out expensive, sticky spit."

Dr. Jeukendrup and Dr. Bridge, though, say they use the mouth-rinsing trick themselves. "You do notice a benefit," Dr. Bridge said. But he noted that in a study, the athletes don't know if they are getting carbohydrates or not. "If you know you are doing it," he said, "then there's a chance it's a placebo effect."

High doses of ursodeoxycholic acid ineffective for NASH patients Drug fails to improve overall liver histology compared to placebo

A study conducted by researchers at Johann Wolfgang Goethe University in Frankfurt, Germany found that high doses of ursodeoxycholic acid (UDCA), suggested by some studies to have a beneficial effect on nonalcoholic steatohepatitis (NASH), does not improve overall histology in these patients. Full findings of this study are published in the August issue of *Hepatology*, a journal of the American Association for the Study of Liver Diseases (AASLD).

According to the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK), NASH ranks as one of the major causes of cirrhosis in America, behind hepatitis C and alcoholic liver disease. Liver transplantation is the only treatment for advanced cirrhosis with liver failure, and transplantation is increasingly performed in people with NASH. Currently, there are no specific therapies for NASH.

Small, open label clinical studies have shown that UDCA positively influenced liver function tests and liver histology in NASH patients, but a two-year prospective double-blind trial with 166 patients at the dosage of 13 mg/kg body weight per day failed to confirm these results. To determine if the dosage of UDCA may have been too low and a reduction of body weight could have contributed to the results, the German research team initiated a multicenter, placebo-controlled double-blind trial with a high dose of UDCA and without weight-lowering diet.

A UDCA dose of 23-28 mg/kg body weight or placebo was administered daily in three divided doses to 147 randomized patients of both sexes, aged 18 years and older. No special diet was recommended and the body weight of the patients remained constant during the study period. The total treatment time for each patient was 18 months. The primary objective was improvement of liver histology by at least 3 points. Secondary criteria were single histological variables and liver biochemistry.

Pre- and post-treatment liver biopsies from each patient were evaluated according to a modified Brunt score (including steatosis, hepatocellular ballooning, lobular inflammation, and portal/lobular fibrosis) as well as the nonalcoholic fatty liver disease activity score (NAS). Using the modified Brunt score, 185 patients with histologically proven NASH were randomized (intention to treat: ITT), 147 were treated per protocol (PP). Using the NAS, 137 patients were confirmed as having NASH, 48 were borderline NASH, and 1 was not NASH.

The results were the same for both scoring systems - no significant improvement in overall histology was detected. Of the single variables, only lobular inflammation improved using both the modified Brunt and NAS scores. In subgroup analyses, significant improvement of lobular inflammation was also observed in males, patients less than 50 years of age, slightly overweight patients, in patients with hypertension and an increased histology score. The fibrosis scores did not change.

"Our study has shown that the high dose of 23 to 28 mg UDCA/kg body weight per day, over a treatment time of 18 months, was unable to improve liver histology and overall liver function when compared to placebo and thus confirms the results of an earlier study using a lower dose over a period of 24 months," concluded study leader Dr. Ulrich F.H. Leuschner.

"Previous investigations may have shown positive results, because, first of all, in most of the studies the number of patients was too small, treatment time was too short, or a control group was missing," he explains. "Secondly, the positive effect of UDCA on the suggested pathogenetic mechanisms has been shown in only a few investigations with a small number of experimental animals and in few patients. Finally, the anticipation of an effect of UDCA in NASH probably depends on an incorrect assumption. Up to now positive effects of UDCA have only been observed in primary biliary cirrhosis, but NASH does not present with features of biliary liver diseases."

Article: "High-Dose Ursodeoxycholic Acid Therapy of Nonalcoholic Steatohepatitis. A Double-Blind, Randomized Placebo-Controlled Trial." Ulrich F.H. Leuschner, Birgit Lindenthal, Günter Herrmann, Joachim C. Arnold, Martin Rössle. Hepatology; Published Online: April 23, 2010 (DOI: 10.1002/hep.23727); Print Issue Date: August 2010.

New hypothesis for human evolution and human nature

It's no secret to any dog-lover or cat-lover that humans have a special connection with animals. But in a new journal article and forthcoming book, paleoanthropologist Pat Shipman of Penn State University argues that this human-animal connection goes well beyond simple affection. Shipman proposes that the interdependency of ancestral humans with other animal species - "the animal connection" - played a crucial and beneficial role in human evolution over the last 2.6 million years.

"Establishing an intimate connection to other animals is unique and universal to our species," said Shipman, a professor of biological anthropology. Her paper describing the new hypothesis for human evolution based on the tendency to nurture members of other species will be published in the August 2010 issue of the journal *Current Anthropology*.

In addition to describing her theory in the scientific paper, Shipman has authored a book for the general public, now in press with W. W. Norton, titled *The Animal Connection*. "No other mammal routinely adopts other species in the wild - no gazelles take in baby cheetahs, no mountain lions raise baby deer," Shipman said. "Every mouthful you feed to another species is one that your own children do not eat. On the face of it, caring for another species is maladaptive, so why do we humans do this?"

Shipman suggests that the animal connection was prompted by the invention of stone tools 2.6-million years ago. "Having sharp tools transformed wimpy human ancestors into effective predators who left many cut marks on the fossilized bones of their prey," Shipman said. Becoming a predator also put our ancestors into direct competition with other carnivores for carcasses and prey. As Shipman explains, the human ancestors who learned to observe and understand the behavior of potential prey obtained more meat. "Those who also focused on the behavior of potential competitors reaped a double evolutionary advantage for natural selection," she said.

Over time, Shipman explains, the volume of information about animals increased, the evolutionary benefits of communicating this knowledge to others increased, and language evolved as an external means of handling and communicating information through symbols. "Though we cannot discover the earliest use of language itself, we can learn something from the earliest prehistoric art with unambiguous content. Nearly all of these artworks depict animals. Other potentially vital topics – edible plants, water, tools or weapons, or relationships among humans - are rarely if ever shown," Shipman said. She sees this disproportion as evidence that the evolutionary pressure to develop an external means of storing and transmitting information - symbolic language - came primarily from the animal connection.

Shipman concludes that detailed information about animals became so advantageous that our ancestors began to nurture wild animals - a practice that led to the domestication of the dog about 32,000 years ago. She argues that, if insuring a steady supply of meat was the point of domesticating animals, as traditionally has been assumed, then dogs would be a very poor choice as an early domesticated species. "Why would you take a ferocious animal like a wolf, bring it into your family and home, and think this was advantageous?" Shipman asks. "Wolves eat so much meat themselves that raising them for food would be a losing proposition."

Shipman suggests, instead, that the primary impetus for domestication was to transform animals we had been observing intently for millennia into living tools during their peak years, then only later using their meat as food. "As living tools, different domestic animals offer immense renewable resources for tasks such as tracking game, destroying rodents, protecting kin and goods, providing wool for warmth, moving humans and goods over long distances, and providing milk to human infants" she said.

Domestication, she explained, is a process that takes generations and puts selective pressure on abilities to observe, empathize, and communicate across species barriers. Once accomplished, the domestication of animals offers numerous advantages to those with these attributes. "The animal connection is an ancient and fundamentally human characteristic that has brought our lineage huge benefits over time," Shipman said. "Our connection with animals has been intimately involved with the evolution of two key human attributes - tool making and language - and with constructing the powerful ecological niche now held by modern humans."

Where the wild veggies are

Cultivated cucumber and melon originated in Asia and Australia

Sites of origin and regions of domestication of many of our most important cultivated plants are still unknown. The botanical genus *Cucumis*, to which both the cucumber (*Cucumis sativus*) and the honeydew melon (*C. melo*) belong, was long thought to have originated and diversified in Africa, because many wild species of *Cucumis* are found there. "A molecular genetic analysis has now shown that the wild populations that gave rise to melons and cucumbers originated in Asia", says LMU botanist Professor Susanne Renner. "In addition, we have found that 25 related species which have never been formally described are found in Asia, Australia and regions around the Indian Ocean." Future genetic studies on *C. sativus* and its wild relatives

should therefore focus on Asia and Australia. The new results are important because the garden cucumber is one of the most widely cultivated vegetable crops, and the species is among the few flowering plants whose genomes have been fully sequenced. According to Renner, "Our study would not have been possible without the resources of the Munich herbarium and Botanical Garden. A large fraction of the plants we have been able to sequence was collected in India, Vietnam and Australia during the 19th century, and most were then forgotten in herbaria, that is, collections of dried plant specimens. Many of these come from locations that no longer have natural vegetation, for example, because they were collected at sites that now lie in built-up areas of cities like Hanoi." (PNAS online, July 2010)

The family Cucurbitaceae includes crop plants, such cucumbers, melons, loofah, and pumpkins. In terms of its economic importance, the cucumber is among the top ten crop plants cultivated worldwide, and the related honeydew melon is also of considerable agronomic significance. Species that belong to the genus *Cucumis* are also popular with botanical researchers. Indeed, the domestic cucumber was the seventh species of flowering plant to have its genome sequenced completely, being preceded by such agricultural heavyweights as rice and grapevine. Over the past 10 years, thousands of scientific papers on the biology of cucumbers and melons have appeared. Many of these studies have used these species as model systems to investigate the mechanism of sex determination during floral development. The question of the genetic origins of the genus *Cucumis*, on the other hand, has received comparatively little attention (the business about the Romans cultivating cucumber is wrong; I can send you a paper on this topic if you are interested). The general consensus among botanists has been that the melon originated in Africa, because putative wild ancestors of the cultivated variety had been identified there. It now turns out that none of these forms is ancestral to the melons we find in our markets and shops.

"We analyzed specific segments of the genetic material from herbarium specimens of more than 100 *Cucumis* species. The samples we used had been collected at various locations in Africa, Australia and Asia", reports Patrizia Sebastian, who is the first author on the new study. "It turned out that the closest living wild relative of the cultivated melon is a native of Australia. The two lines diverged about 3 million years ago, and they last shared a common ancestor with their more distant relatives in Asia and Australia about 10 million years ago." The total number of *Cucumis* species found in Asia and Australia is now around 25, and they branched off from their African relatives some 12 million years ago.

Nine of the 25 species were identified for the first time in the new study. Renner and her colleagues are preparing formal systematic descriptions of the new species for a specialized journal. Taken together, the results argue that the common ancestor of cucumber and melon originated on the continent of Asia. Possible ancestral populations from which the domesticated forms derive have been localized in the Himalayas. The genetic diversity of the varieties of *C. melo* that occur in India and China is particularly striking. "Our data also prove that the closest living relative of our garden cucumber is the species *C. hystrix*, which is found in the Eastern Himalayas", says Renner. "Future investigations of the phylogeny of *Cucumis* should therefore focus on Asia and Australia."

The new findings once again emphasize the great significance for modern botanical research of the herbarium materials that have been assembled over centuries and are now held in institutions like herbarium of the Bavarian Natural History Collections and the LMU's own herbarium. "Many of the plants we examined in this study were collected in the course of the 19th century, and most were then ignored and forgotten", says Renner, who is Director of these herbaria and the Munich Botanic Garden. "In many ways, this material represents an irreplaceable treasure, because the habitats in which much of it was collected no longer exist. *Cucumis debilis*, for instance, no longer grows at the location from which it was last collected in 1931. The site is now a suburb of Hanoi."

Cucumber (Cucumis sativus) and melon (C. melo) have numerous wild relatives in Asia and Australia, and the sister species of melon is from Australia Patrizia Sebastian, Hanno Schaefer, Ian R. H. Telford, and Susanne S. Renner PNAS online, week of July 19 2010

Of Bugs and Brains: Gut Bacteria Affect Multiple Sclerosis

ScienceDaily (July 20, 2010) - Biologists at the California Institute of Technology (Caltech) have demonstrated a connection between multiple sclerosis (MS) - an autoimmune disorder that affects the brain and spinal cord - and gut bacteria. The work - led by Sarkis K. Mazmanian, an assistant professor of biology at Caltech, and postdoctoral scholar Yun Kyung Lee - appears online the week of July 19-23 in the Proceedings of the National Academy of Sciences.

Multiple sclerosis results from the progressive deterioration of the protective fatty myelin sheath surrounding nerve cells. The loss of myelin hinders nerve cells from communicating with one another, leading to a host of neurological symptoms including loss of sensation, muscle spasms and weakness, fatigue, and pain. Multiple

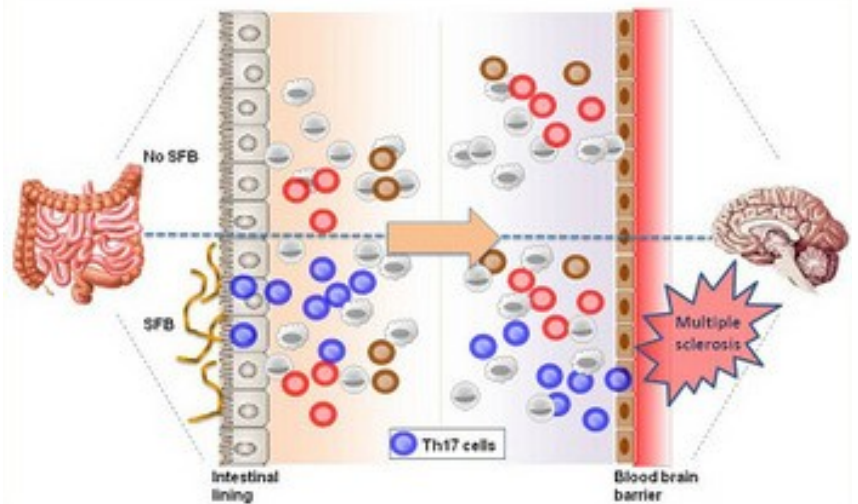
sclerosis is estimated to affect about half a million people in the United States alone, with rates of diagnosis rapidly increasing. There is currently no cure for MS.

Although the cause of MS is unknown, microorganisms seem to play some sort of role. "In the literature from clinical studies, there are papers showing that microbes affect MS," Mazmanian says. "For example, the disease gets worse after viral infections, and bacterial infections cause an increase in MS symptoms."

On the other hand, he concedes, "it seems counterintuitive that a microbe would be involved in a disease of the central nervous system, because these are sterile tissues."

And yet, as Mazmanian found when he began examining the multiple sclerosis literature, the suggestion of a link between bacteria and the disease is more than anecdotal. Notably, back in 1993, Caltech biochemist Leroy Hood - who was then at the University of Washington - published a paper describing a genetically engineered strain of mouse that developed a lab-induced form of multiple sclerosis known as experimental autoimmune encephalomyelitis, or EAE.

When Hood's animals were housed at Caltech, they developed the disease. But, oddly, when the mice were shipped to a cleaner biotech facility - where their resident gut bacterial populations were reduced - they didn't get sick. The question was, why? At the time, Mazmanian says, "the authors speculated that some environmental component was modulating MS in these animals." Just what that environmental component was, however, remained a mystery for almost two decades.



In the absence of bacteria in the intestines, pro-inflammatory Th17 cells do not develop in either the gut or the central nervous system; and animals do not develop disease (top panel). When animals are colonized with symbiotic segmented filamentous bacteria, Th17 cell differentiation is induced in the gut. Th17 cells promote experimental autoimmune encephalomyelitis, an animal model for multiple sclerosis. In this way, non-pathogenic bacteria of the microbiota promote disease by shaping the immune response in both the gut and the brain (top panel). (Credit: Lee, Mazmanian/Caltech; modified from Savidge TC et al. *Laboratory Investigation* 2007)

But Mazmanian - whose laboratory examines the relationships between gut microbes, both harmful and helpful, and the immune systems of their mammalian hosts - had a hunch that intestinal bacteria were the key. "As we gained an appreciation for how profoundly the gut microbiota can affect the immune system, we decided to ask if symbiotic bacteria are the missing variable in these mice with MS," he says.

To find out, Mazmanian and his colleagues tried to induce MS in animals that were completely devoid of the microbes that normally inhabit the digestive system. "Lo and behold, these sterile animals did not get sick," he says.

Then the researchers decided to see what would happen if bacteria were reintroduced to the germ-free mice. But not just any bacteria. They inoculated mice with one specific organism, an unculturable bug from a group known as segmented filamentous bacteria. In prior studies, these bacteria had been shown to lead to intestinal inflammation and, more intriguingly, to induce in the gut the appearance of a particular immune-system cell known as Th17. Th17 cells are a type of T helper cell - cells that help activate and direct other immune system cells. Furthermore, Th17 cells induce the inflammatory cascade that leads to multiple sclerosis in animals.

"The question was, if this organism is inducing Th17 cells in the gut, will it be able to do so in the brain and central nervous system?" Mazmanian says. "Furthermore, with that one organism, can we restore to sterile animals the entire inflammatory response normally seen in animals with hundreds of species of gut bacteria?"

The answer? Yes on all counts. Giving the formerly germ-free mice a dose of one species of segmented filamentous bacteria induced Th17 not only in the gut but in the central nervous system and brain - and caused the formerly healthy mice to become ill with MS-like symptoms.

"It definitely shows that gut microbes have a strong role in MS, because the genetics of the animals were the same. In fact, everything was the same except for the presence of those otherwise benign bacteria, which are clearly playing a role in shaping the immune system," Mazmanian says. "This study shows for the first time that specific intestinal bacteria have a significant role in affecting the nervous system during MS - and they do so from the gut, an anatomical location very, very far from the brain."

Mazmanian and his colleagues don't, however, suggest that gut bacteria are the direct cause of multiple sclerosis, which is known to be genetically linked. Rather, the bacteria may be helping to shape the immune system's inflammatory response, thus creating conditions that could allow the disease to develop. Indeed, multiple sclerosis also has a strong environmental component; identical twins, who possess the same genome and share all of their genes, only have a 25 percent chance of sharing the disease. "We would like to suggest that gut bacteria may be the missing environmental component," he says.

For their part, Th17 cells are needed for the immune system to properly combat infection. Problems only arise when the cells are activated in the absence of infection - just as disease can arise, Mazmanian and others suspect, when the species composition of gut bacteria become imbalanced, say, by changes in diet, because of improved hygiene (which kills off the beneficial bacteria as well as the dangerous ones), or because of stress or antibiotic use. One impact of the dysregulation of normal gut bacterial populations - a phenomenon dubbed "dysbiosis" - may be the rising rate of multiple sclerosis seen in recent years in more hygienic societies.

"As we live cleaner, we're not just changing our exposure to infectious agents, but we're changing our relationship with the entire microbial world, both around and inside us, and we may be altering the balance between pro- and anti-inflammatory bacteria," leading to diseases like MS, Mazmanian says. "Perhaps treatments for diseases such as multiple sclerosis may someday include probiotic bacteria that can restore normal immune function in the gut... and the brain."

The work was supported by funding from the California Institute of Technology, the Weston Havens Foundation, and the Edward Mallinckrodt, Jr. Foundation.

Male fetuses ignore their stressed-out mothers

*** 15:00 20 July 2010 by Wendy Zukerman**

Male fetuses ignore their mothers' response to stress – unlike females, which are very sensitive to it. The finding could lead to better treatments for male fetuses at risk of premature birth.

It is known that when a pregnant woman produces the stress hormone cortisol, it can cross the placenta. But it has been unclear how this affects fetal development, and whether female and male fetuses respond differently to the hormone.

During an asthma attack, high levels of cortisol are released. So Vicki Clifton and colleagues at the University of Adelaide in South Australia investigated the effect of cortisol on fetuses by following 123 asthmatic women and 51 healthy women during their pregnancies, recording the severity of each woman's asthma and her medication at 12, 18 and 30 weeks of pregnancy.

Forty-five minutes after the women gave birth, Clifton and her team measured the cortisol in their umbilical cord blood and analysed the placenta for the expression of genes related to stress response. She also recorded the newborn's sex and birth weight.

Stressful information

Baby girls born to women with moderate to severe asthma had higher levels of cortisol in their cord blood – an average of 245 millimoles per litre – compared with girls born to controls and mildly asthmatic women, who averaged 202 and 209 millimoles per litre respectively.

However, no difference in cortisol levels was observed in baby boys born to either group.

The team also observed that 22.5 per cent of girls born to asthmatic women were small for their gestational age, meaning they were among the lightest 10 per cent of all babies born worldwide. But just 9.5 per cent of girls born to healthy women fell into this group. Again, no difference was observed in boys from either group.

"Females are very sensitive to what's happening in mum's body, but males just ignore it," says Clifton, who presented her results at the University of Adelaide last week.

Small strategy

Low birth weight is associated with hypertension, diabetes and depression in adulthood, but a smaller fetus copes better with adversity in the womb, such as a drop in nutrients during an asthma attack. But the males take a gamble, says Clifton, ignoring the rise in cortisol and continuing to grow at a regular pace.

"There must be some benefit in males being bigger at birth, and this is worth the risk [of being affected by an associated drop in nutrients]," says Tim Moss, a prenatal physiologist at Monash University in Melbourne, Australia.

Moss says the work has important clinical applications that "could help us to reduce the vulnerability of male infants".

For example, in obstetric practice, stress hormones are routinely administered to women who are at risk of preterm delivery to induce faster maturation of the fetus. The treatment seems less effective in males than females – this study could explain why, and lead to new methods of aiding male development.

Adventures in Very Recent Evolution

By NICHOLAS WADE

Ten thousand years ago, people in southern China began to cultivate rice and quickly made an all-too-tempting discovery - the cereal could be fermented into alcoholic liquors. Carousing and drunkenness must have started to pose a serious threat to survival because a variant gene that protects against alcohol became almost universal among southern Chinese and spread throughout the rest of China in the wake of rice cultivation.

The variant gene rapidly degrades alcohol to a chemical that is not intoxicating but makes people flush, leaving many people of Asian descent a legacy of turning red in the face when they drink alcohol.

The spread of the new gene, described in January by Bing Su of the Chinese Academy of Sciences, is just one instance of recent human evolution and in particular of a specific population's changing genetically in response to local conditions.

Scientists from the Beijing Genomics Institute last month discovered another striking instance of human genetic change. Among Tibetans, they found, a set of genes evolved to cope with low oxygen levels as recently as 3,000 years ago. This, if confirmed, would be the most recent known instance of human evolution.

Many have assumed that humans ceased to evolve in the distant past, perhaps when people first learned to protect themselves against cold, famine and other harsh agents of natural selection. But in the last few years, biologists peering into the human genome sequences now available from around the world have found increasing evidence of natural selection at work in the last few thousand years, leading many to assume that human evolution is still in progress.

"I don't think there is any reason to suppose that the rate has slowed down or decreased," says Mark Stoneking, a population geneticist at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany.

So much natural selection has occurred in the recent past that geneticists have started to look for new ways in which evolution could occur very rapidly. Much of the new evidence for recent evolution has come from methods that allow the force of natural selection to be assessed across the whole human genome. This has been made possible by DNA data derived mostly from the Hap Map, a government project to help uncover the genetic roots of complex disease. The Hap Map contains samples from 11 populations around the world and consists of readings of the DNA at specific sites along the genome where variations are common.

One of the signatures of natural selection is that it disturbs the undergrowth of mutations that are always accumulating along the genome. As a favored version of a gene becomes more common in a population, genomes will look increasingly alike in and around the gene. Because variation is brushed away, the favored gene's rise in popularity is called a sweep. Geneticists have developed several statistical methods for detecting sweeps, and hence of natural selection in action.

About 21 genome-wide scans for natural selection had been completed by last year, providing evidence that 4,243 genes - 23 percent of the human total - were under natural selection. This is a surprisingly high proportion, since the scans often miss various genes that are known for other reasons to be under selection. Also, the scans can see only recent episodes of selection - probably just those that occurred within the last 5,000 to 25,000 years or so. The reason is that after a favored version of a gene has swept through the population, mutations start building up in its DNA, eroding the uniformity that is evidence of a sweep.

Unfortunately, as Joshua M. Akey of the University of Washington in Seattle, pointed out last year in the journal *Genome Research*, most of the regions identified as under selection were found in only one scan and ignored by the 20 others. The lack of agreement is "sobering," as Dr. Akey put it, not least because most of the scans are based on the same Hap Map data.

From this drunken riot of claims, however, Dr. Akey believes that it is reasonable to assume that any region identified in two or more scans is probably under natural selection. By this criterion, 2,465 genes, or 13 percent, have been actively shaped by recent evolution. The genes are involved in many different biological processes, like diet, skin color and the sense of smell.

A new approach to identifying selected genes has been developed by Anna Di Rienzo at the University of Chicago. Instead of looking at the genome and seeing what turns up, Dr. Di Rienzo and colleagues have started with genes that would be likely to change as people adopted different environments, modes of subsistence and diets, and then checked to see if different populations have responded accordingly.

She found particularly strong signals of selection in populations that live in polar regions, in people who live by foraging, and in people whose diets are rich in roots and tubers. In Eskimo populations, there are signals of selection in genes that help people adapt to cold. Among primitive farming tribes, big eaters of tubers, which contain little folic acid, selection has shaped the genes involved in synthesizing folic acid in the body, Dr. Di Rienzo and colleagues reported in May in the *Proceedings of the National Academy of Sciences*.

The fewest signals of selection were seen among people who live in the humid tropics, the ecoregion where the ancestral human population evolved. “One could argue that we are adapted to that and that most signals are seen when people adapt to new environments,” Dr. Di Rienzo said in an interview.

One of the most visible human adaptations is that of skin color. Primates have unpigmented skin beneath their fur. But when humans lost their fur, perhaps because they needed bare skin to sweat efficiently, they developed dark skin to protect against ultraviolet light. Coloring the skin may sound simple, but nature requires at least 25 different genes to synthesize, package and distribute the melanin pigment that darkens the skin and hair. The system then had to be put into reverse when people penetrated the northern latitudes of Europe and Asia and acquired lighter skin, probably to admit more of the sunlight required to synthesize vitamin D.

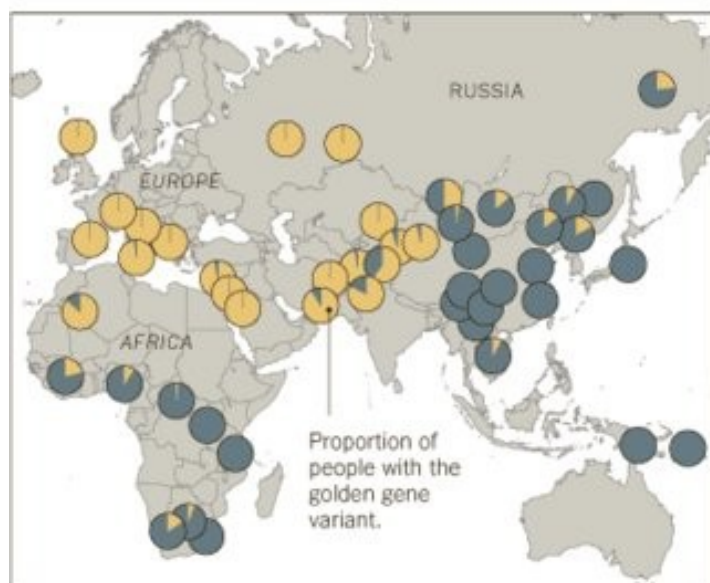
Several of the 25 skin genes bear strong signatures of natural selection, but natural selection has taken different paths to lighten people’s skin in Europe and in Asia. A special version of the golden gene, so called because it turns zebrafish a rich yellow color, is found in more than 98 percent of Europeans but is very rare in East Asians. In them, a variant version of a gene called DCT may contribute to light skin. Presumably, different mutations were available in each population for natural selection to work on. The fact that the two populations took independent paths toward developing lighter skin suggests that there was not much gene flow between them.

East Asians have several genetic variants that are rare or absent in Europeans and Africans. Their hair has a thicker shaft. A version of a gene called EDAR is a major determinant of thicker hair, which may have evolved as protection against cold, say a team of geneticists led by Ryosuke Kimura of Tokai University School of Medicine in Japan.

Most East Asians also have a special form of a gene known as ABCC11, which makes the cells of the ear

Genetic Changes

Researchers have found increasing evidence of recent human evolution in response to local changes in diet, disease and climate.

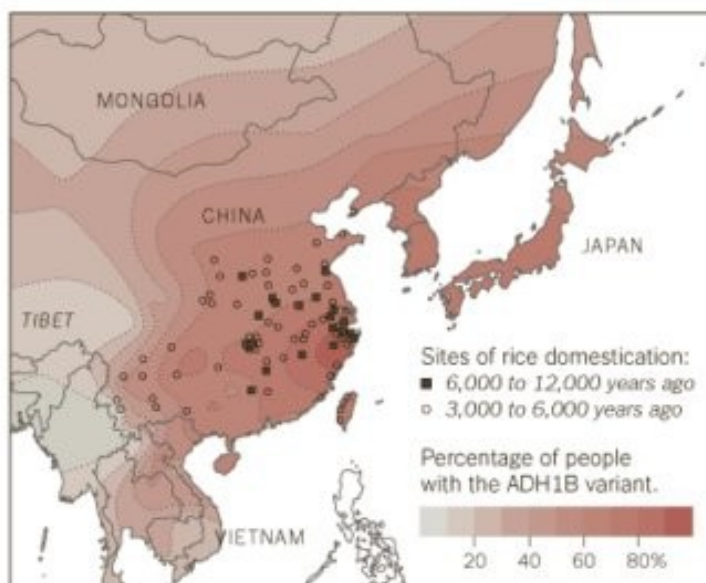


SKIN COLOR Europeans and Asians probably acquired lighter skin to better synthesize vitamin D. A variant known as the golden gene is found in more than 98 percent of Europeans but is rare in East Asia, where lighter skin is thought to derive from a different set of genes.

Sources: *Molecular Biology and Evolution*; *BMC Evolutionary Biology*

produce dry earwax. Most Africans and Europeans, on the other hand, possess the ancestral form of the gene, which makes wet earwax. It is hard to see why dry earwax would confer a big survival advantage, so the Asian version of the gene may have been selected for some other property, like making people sweat less, says a team led by Koh-ichiro Yoshiura of Nagasaki University.

Most variation in the human genome is neutral, meaning that it arose not by natural selection but by processes like harmless mutations and the random shuffling of the genome between generations. The amount of this genetic diversity is highest in African populations. Diversity decreases steadily the further a population has migrated from the African homeland, since each group that moved onward carried away only some of the diversity of its parent population. This steady decline in diversity shows no discontinuity between one population and the next, and has offered no clear explanation as to why one population should differ much from another. But selected genes show a different pattern: Evidence from the new genome-wide tests for selection show that most selective pressures are focused on specific populations.



ALCOHOL A variation in a gene called ADH1B protects against intoxication, making the skin flush when a person drinks. The variant became almost universal among southern Chinese after rice cultivation and fermentation began about 10,000 years ago.

THE NEW YORK TIMES

One aspect of this pattern is that there seem to be more genes under recent selection in East Asians and Europeans than in Africans, possibly because the people who left Africa were then forced to adapt to different environments. "It's a reasonable inference that non-Africans were becoming exposed to a wide variety of novel climates," says Dr. Stoneking of the Max Planck Institute.

The cases of natural selection that have been tracked so far take the form of substantial sweeps, with a new version of a gene being present in a large percentage of the population. These hard sweeps are often assumed to start from a novel mutation. But it can take a long time for the right mutation to occur, especially if there is a very small target, like the region of DNA that controls a gene. In the worst case, the waiting time would be 300,000 generations, according to a calculation by Jonathan Pritchard, a population geneticist at the University of Chicago. And indeed, there are not many hard sweeps in the human genome.

But the new evidence that humans have adapted rapidly and extensively suggests that natural selection must have other options for changing a trait besides waiting for the right mutation to show up. In an article in *Current Biology* in February, Dr. Pritchard suggested that a lot of natural selection may take place through what he called soft sweeps.

Soft sweeps work on traits affected by many genes, like height. Suppose there are a hundred genes that affect height (about 50 are known already, and many more remain to be found). Each gene exists in a version that enhances height and a version that does not. The average person might inherit the height-enhancing version of 50 of these genes, say, and be of average height as a result.

Suppose this population migrates to a region, like the Upper Nile, where it is an advantage to be very tall. Natural selection need only make the height-enhancing versions of these 100 genes just a little more common in the population, and now the average person will be likely to inherit 55 of them, say, instead of 50, and be taller as a result. Since the height-enhancing versions of the genes already exist, natural selection can go to work right away and the population can adapt quickly to its new home.

Researchers pinpoint key stem cells for eating and sex

GW's Dr. Anthony-Samuel LaMantia publishes research on neural precursors in the developing olfactory epithelium

WASHINGTON – New research, published in the journal *Development*, by Dr. Anthony-Samuel LaMantia, professor of Pharmacology & Physiology and director of the newly formed GW Institute for Neuroscience, and his colleagues have identified the stem cells that generate three critical classes of nerve cells – olfactory receptors (ORNs), vomeronasal (VRNs) and gonadotropin releasing hormone (GnRH) neurons – that are responsible for enabling animals and humans, to eat, interact socially and reproduce.

This research is the first evidence identifying these stem cells. By studying mice at the earliest stages of embryonic development, LaMantia and his colleagues were able to identify the location of these cells, confirm that they divide slowly and symmetrically - thus making more stem cells, have a distinct molecular identity, and give rise to all cell types in the tissue - including ORNs, VRNs and GnRH neurons. These embryonic olfactory stem cells also are ultimately responsible for generating stem cells that remain in the lining of the nose throughout life and make new ORNs and VRNs. Thus these stem cells are also essential to enable a rare example of nervous system regeneration that continues throughout life.

"By identifying these stem cells, our research will help physicians understand why people have certain genetic, neurological, and mental disabilities. Olfaction is often compromised early in the course of a number of serious diseases including autism, schizophrenia, and Alzheimer's disease, and GnRH deficiency is important in many cases of infertility. It is my hope that in the future, we will combine this sort of cell and molecular biology with clinical practice to develop better treatments for patients with these disorders," said Dr. LaMantia.

To identify the early olfactory stem cell, Dr. LaMantia and his colleagues used multiple methods to define the identity and potential of dividing cells in the embryonic tissue that eventually becomes the nasal epithelium - the sheet of nerve cells that lines the nasal cavity. The researchers studied these tissues using molecular markers to distinguish different classes of cells and recombinant DNA technology as well as mutant mice to assess how several key genes define olfactory stem cell identity. They found a subset of cells that divide slowly and symmetrically - suggesting that these were indeed, the stem cells. They also showed that these cells were self renewing - another essential characteristic of stem cells. They defined several molecules that influence whether these stem cells remain as stem cells or divide terminally to make olfactory, vomeronasal and GnRH neurons. Finally, they showed that these stem cells uniquely give rise to ORNs, VRNs, and GnRH neurons.

*To learn more about this research, view the journal *Development* article: <http://dev.biologists.org/content/137/15/2471>*

Most Massive Star Discovered - Shatters Record **Astronomers "really taken aback" by stellar behemoth.**

Andrew Fazekas for National Geographic News

A newfound star has shattered the record as the most massive stellar monster ever seen, astronomers announced today.

Weighing in at a whopping 265 times the mass of our sun, the behemoth may have actually slimmed down since birth, when it likely tipped the scales at 320 times the sun's mass.

The discovery could rewrite the laws of stellar physics, since it's long been thought that stars beyond a certain mass would be too unstable to survive.



The most massive star ever found looms behind other young star types in an artist's impression. Image courtesy M. Kornmesser, ESO

"We are really taken aback, because up until now the astronomical community at large has assumed that the upper size limit for stars would be around 150" times the mass of the sun, said study co-author Richard Parker, an astronomer at the University of Sheffield in the U.K.

"This giant could really revolutionize the way we think about how stars form and die in clusters and galaxies."

Most Massive Star to Blow Itself Apart?

Parker's team found the stellar monster in images taken with the European Southern Observatory's Very Large Telescope in Chile. The star is tucked inside a dense cluster of other hot, young, massive stars in one of the Milky Way's satellite galaxies, the Large Magellanic Cloud.

Dubbed R136a1, the record-breaking star is so massive that it burns its hydrogen fuel at an unprecedented rate - fast enough that the star is considered middle-aged at about a million years old. By contrast, our sun is about five billion years old and still has another five billion years to go.

"Because there are so very few places where there is enough gas that can collect and form such massive stars, we may very well be seeing the limit of how large a star can get," Parker added.

This stellar surprise, Parker said, might also add to evidence for a rare class of supervolent explosions known as pair-instability supernovae. (See "Biggest Star Explosion Seen; Was Rare, 'Clean' Death.")

The most massive stars are generally thought to die in huge explosions that scatter the stars' outer layers but leave behind dense cores - either neutron stars or black holes.

"This fast-burning stellar giant, however, may be large enough to actually completely blow itself apart in a titanic explosion without leaving behind any corpse whatsoever," the trademark of a pair-instability explosion, Parker said. "We are fortunate to have caught sight of it when we did." The supermassive star is described in a paper in the July issue of the Monthly Notices of the Royal Astronomical Society.

Study links more time spent sitting to higher risk of death

Risk found to be independent of physical activity level

A new study from American Cancer Society researchers finds it's not just how much physical activity you get, but how much time you spend sitting that can affect your risk of death. Researchers say time spent sitting was independently associated with total mortality, regardless of physical activity level. They conclude that public health messages should promote both being physically active and reducing time spent sitting. The study appears early online in the American Journal of Epidemiology.

Increasing obesity levels in the United States are widely predicted to have major public health consequences. A growing epidemic of overweight and obesity has been attributed in part to reduced overall physical activity. And while several studies support a link between sitting time and obesity, type 2 diabetes, cardiovascular disease risk factors (11, 16, 17), and unhealthy dietary patterns in children and adults (18-20), very few studies have examined time spent sitting in relation to total mortality (21-23). Thus, public health guidelines focus largely on increasing physical activity with little or no reference to reducing time spent sitting.

To explore the association between sitting time and mortality, researchers led by Alpa Patel, Ph.D. analyzed survey responses from 123,216 individuals (53,440 men and 69,776 women) who had no history of cancer, heart attack, stroke, or emphysema/other lung disease enrolled in the American Cancer Society's Cancer Prevention II study in 1992. They examined the amount of time spent sitting and physical activity in relation to

mortality between 1993 and 2006. They found that more leisure time spent sitting was associated with higher risk of mortality, particularly in women. Women who reported more than six hours per day of sitting were 37 percent more likely to die during the time period studied than those who sat fewer than 3 hours a day. Men who sat more than 6 hours a day were 18 percent more likely to die than those who sat fewer than 3 hours per day. The association remained virtually unchanged after adjusting for physical activity level. Associations were stronger for cardiovascular disease mortality than for cancer mortality.

When combined with a lack of physical activity, the association was even stronger. Women and men who both sat more and were less physically active were 94% and 48% more likely, respectively, to die compared with those who reported sitting the least and being most active.

"Several factors could explain the positive association between time spent sitting and higher all-cause death rates," said Dr. Patel. "Prolonged time spent sitting, independent of physical activity, has been shown to have important metabolic consequences, and may influence things like triglycerides, high density lipoprotein, cholesterol, fasting plasma glucose, resting blood pressure, and leptin, which are biomarkers of obesity and cardiovascular and other chronic diseases."

The authors conclude that "public health messages and guidelines should be refined to include reducing time spent sitting in addition to promoting physical activity. Because a sizeable fraction of the population spends much of their time sitting, it is beneficial to encourage sedentary individuals to stand up and walk around as well as to reach optimal levels of physical activity."

Article: "Leisure Time Spent Sitting in Relation to Total Mortality in a Prospective Cohort of US Adults." Alpa V. Patel, Leslie Bernstein, Anusila Deka, Heather Spencer Feigelson, Peter T. Campbell, Susan M. Gapstur, Graham A. Colditz, and Michael J. Thun. Am J Epidemiol Published online July 22, 2010 (DOI: 10.1093/aje/kwq155). Link to abstract: <http://aje.oxfordjournals.org/cgi/content/abstract/kwq155>

Could diabetes be in your bones?

Our bones have much greater influence on the rest of our bodies than they are often given credit for, according to two new studies in the July 23 issue of *Cell*, a Cell Press publication. Both studies offer new insights into the interplay between bone and blood sugar, based on signals sent via insulin and a bone-derived hormone known as osteocalcin.

Mice whose bones can't respond to insulin develop high blood sugar and insulin resistance, both hallmarks of diabetes. Those symptoms are tied to a drop in osteocalcin. The findings suggest that osteocalcin, or perhaps a drug that targets bone, might hold promise in fighting the global epidemic of type 2 diabetes, according to the researchers.

"Our study reveals a key molecular link between bone remodeling and metabolism," said Gerard Karsenty of Columbia University. "Bone is an organ that has to pay attention to where calories are going," added Thomas Clemens of Johns Hopkins University School of Medicine. "It talks to muscle, fat, the pancreas. It's a player in energy metabolism."

And perhaps that makes a lot of sense, Karsenty said. The remodeling of bone relies on two cell types, bone-building osteoblasts and bone-resorbing osteoclasts, making bone the only organ with a cell type that is entirely focused on destroying host tissue. "On a daily basis, the formation of bone is expensive in terms of energy," he said.

In fact, the idea that the skeleton is much more than a reservoir for calcium and phosphate isn't entirely new, the researchers said. Earlier evidence by Karsenty's group had shown links between bone and the fat hormone leptin. (Obese adults are significantly less likely to develop osteoporosis.)

Scientists also had evidence that osteoblasts might respond to insulin in important ways. Osteoblasts bear insulin receptors and when treated with insulin show signs of collagen synthesis and take up more glucose, Clemens' team notes. People with type 1 diabetes due to a lack of insulin can also develop weakened bones.

Karsenty's team describes bone as a multitasker. It has mechanical, hematopoietic (blood-producing) and metabolic functions. It also acts as an endocrine organ through the release of osteocalcin hormone, which favors glucose metabolism when in its active form.

Still, Clemens said he was surprised by what they saw after developing a mouse lacking insulin receptors only in their osteoblasts. "The mice started to get fat," he said. They showed changes in their biochemistry that were consistent with insulin resistance. They also had low osteocalcin levels and fewer osteoblasts to produce less bone. With age, the animals became even fatter and developed more marked high blood sugar accompanied by severe glucose intolerance and insulin resistance. Those symptoms improved with osteocalcin treatment.

Karsenty's group presents independent evidence for the important role of insulin in bone for keeping glucose in check through osteocalcin, in what he refers to as a "feed-forward loop." But his group goes a step further to suggest that bone-resorbing osteoclasts (not just osteoblasts) have a place in this too.

Karsenty explains that bone-building osteoblasts actually control bone resorption by osteoclasts, a process that takes place under very acidic conditions. Those conditions would also favor the chemical modification necessary to produce active osteocalcin, which can escape bone to act as a hormone.

That could be important to those who take osteoporosis drugs designed to block bone resorption, Karsenty suggests. "It's a red flag," he said. "Osteoporotic patients treated with [bone resorption inhibitors] may be at risk of glucose intolerance."

The researchers include Mathieu Ferron, Columbia University, New York, NY; Jianwen Wei, Columbia University, New York, NY; Tatsuya Yoshizawa, Columbia University, New York, NY; Andrea Del Fattore, University of L'Aquila, L'Aquila, Italy; Ronald A. DePinho, Harvard Medical School, Boston, MA; Anna Teti, University of L'Aquila, L'Aquila, Italy; Patricia Ducy, Columbia University, New York, NY; and Gerard Karsenty, Columbia University, New York, NY.

The New Normal?: Average Global Temperatures Continue to Rise 2010 may prove to be the hottest year since record keeping began in 1880

By David Biello

Hot summers (and balmy winters) may simply be the new normal, thanks to carbon dioxide lingering in the atmosphere for centuries.

This trend reaches back further than a couple of years. There have been exactly zero months, since February 1985, with average temperatures below those for the entire 20th century. (And those numbers are not as dramatic as they could be, because the last 15 years of the 20th century included in this period raised its average temperature, thereby lessening the century-long heat differential.) That streak - 304 months and counting - was certainly not broken in June 2010, according to the U.S. National Oceanic and Atmospheric Administration (NOAA). Last month saw average global surface temperatures 0.68 degree Celsius warmer than the 20th-century average of 15.5 degrees C for June - making it the warmest June at ground level since record-keeping began in 1880.

Not only that, June continued another streak - this year, it was the fourth warmest month on record in a row globally, with average combined land and sea surface temperatures for the period at 16.2 degrees C. The high heat in much of Asia and Europe as well as North and South America more than counterbalanced some local cooling in southern China, Scandinavia and the northwestern U.S. - putting 2010 on track to surpass 2005 as the warmest year on record. Even in the higher reaches of the atmosphere - where cooling of the upper levels generally continues thanks to climate change below - June was the second warmest month since satellite record-keeping began in 1978, trailing only 1998.

"Warmer than average global temperatures have become the new normal," says Jay Lawrimore, chief of climate analysis at NOAA's National Climatic Data Center, which tracks these numbers. "The global temperature has increased more than 1 degree Fahrenheit [0.7 degree C] since 1900 and the rate of warming since the late 1970s has been about three times greater than the century-scale trend."

So what does the near future hold in terms of heat waves and record-breaking highs? Depending on how quickly La Niña conditions strengthen in the Pacific Ocean (and a host of other factors), this year could surpass previous records or at least take its place as one of the warmer years on record.

The short-term is fairly clear to climatologist James Hansen of the NASA Goddard Institute for Space Studies. "A new record global temperature, for the period with instrumental measurements, should be set within the next few months," he wrote in an unpublished paper in March.

But record global temperature for the calendar year might not occur if El Niño conditions deteriorate rapidly by mid-2010 into La Niña conditions, Hansen added.

That is exactly what is happening right now, according to NOAA. Sea surface temperatures in the Pacific Ocean - which play a key role in determining global temperatures - continued to decline in June, transforming from the heated condition known as El Niño to the cooler condition known as La Niña. A similar change in 2007 ended that year's chance to surpass 2005 as the warmest year on record. "La Niña typically contributes to a lower global average temperature than do neutral or El Niño conditions," Lawrimore explains. "The forecasted development of La Niña has the potential to bring the annual 2010 global average temperature below a record for the year as a whole."

Nevertheless, record highs are already being recorded across the globe: Pakistan set Asia's record for highest temperature on record, notching up 53.5 degrees C on May 26 - one of nine countries to set high heat records so far this year. There are now roughly twice as many days with record highs than days with record lows, according to research from the National Center for Atmospheric Research. And warmer than usual temperatures in the ocean have prompted coral bleaching in the Indian Ocean and offshore of Southeast Asia; NOAA also warns there is "high potential" for such bleaching to develop in the Caribbean this summer.

All this heat comes at a time when the sun - despite a recent uptick in solar storm activity, much of it associated with sunspots, since late 2008 - continues to pump out slightly less energy. This diminished solar radiation should be promoting a slight cooling but is apparently outweighed by the ongoing accumulation of atmospheric greenhouse gases, particularly carbon dioxide, as scientists have predicted for more than a century. Of course year to year variations in weather cannot be conclusively tied to climate change, which is best measured by a multiyear trend, such as the long-term trend of warming into which this year fits - 2000 to 2010 is already the warmest decade since records have been kept and the 10 warmest average annual surface temperatures have all occurred in the past 15 years.

Precipitation patterns are changing as well - southern regions in China, Europe and India, along with the U.S. Midwest and Northwest all saw more rainfall than usual in June. Similar factors resulted in Nashville being drowned this spring, among other impacts. Meanwhile, drought afflicted Australia, eastern Asia, northern India and northeastern South America. The U.K. is experiencing the lowest rainfall since 1929.

Regardless, the long-term trend is clearly continued warming, which is "very likely" (with more than 90 percent certainty) caused by greenhouse gases emitted in the course of human activity, according to climate scientists. And climate model research from Stanford University set to be published in *Geophysical Research Letters* shows that extended heat waves are likely to become more commonplace in the U.S. by 2040 - and predicts hotter and drier seasons over the next decade.

"Frankly, I was expecting that we'd see large temperature increases later this century with higher greenhouse gas levels and global warming," Stanford climate scientist Noah Diffenbaugh, who headed up the research, said in a prepared statement. "I did not expect to see anything this large within the next three decades."

"Heat waves are expected to become more frequent and intense in the 21st century," NOAA's Lawrimore adds. "Today's rare heat waves will likely become the typical weather conditions by the last half of the century."

"Fresh" Crater Found in Egypt; Changes Impact Risk?

Andrew Fazekas for National Geographic News

A small impact crater discovered in the Egyptian desert could change estimates for impact hazards to our planet, according to a new study.

One of the best preserved craters yet found on Earth, the Kamil crater was initially discovered in February during a survey of satellite images on Google Earth. Researchers think the crater formed within the past couple thousand years.

The Italian-Egyptian team that found the crater in pictures recently visited and studied the 147-foot-wide (45-meter-wide), 52-foot-deep (16-meter-deep) hole. The team also collected thousands of pieces of the space rock that littered the surrounding desert.

Based on their calculations, the team thinks that a 4.2-foot-wide (1.3-meter-wide) solid iron meteor weighing 11,023 to 22,046 pounds (5,000 to 10,000 kilograms) smashed into the desert—nearly intact—at speeds exceeding 2.1 miles (3.5 kilometers) a second.



Geophysicists work in the newfound Kamil crater in an undated picture. Photograph courtesy Museo Nazionale dell'Antartide Università di Siena

There are no hard numbers for how many meteors this size might currently be on a collision course with Earth, but scientists think the potential threats could be in the tens of thousands.

Current impact models state that iron meteors around this size and mass should break into smaller chunks before impact. (Related: "Comet 'Shower' Killed Ice Age Mammals?")

Instead, the existence of the newfound crater implies that up to 35 percent of these iron giants may actually survive whole—and thus have greater destructive power.

Egypt Crater Still Shows Splatter

Estimating impact hazards to Earth isn't an exact science, since only 176 impact craters have been discovered so far, according to the Earth Impact Database, a resource maintained by the University of New Brunswick in Canada.

Most models are based on the number of impact craters on the moon, which has almost no atmosphere and so doesn't experience the same erosion processes as those on Earth.

"Current models predict that around a thousand to ten thousand such craters should have formed [on Earth] in one million years," said study co-author Luigi Folco, a scientist with the University of Siena in Italy.

"The reason why they are rare, however, is that, on Earth, weathering rates are high—small craters are usually easily eroded or buried." (Related: "India Asteroid Killed Dinosaurs, Made Largest Crater?")

Folco and colleagues were particularly surprised to find that the newfound, bowl-shaped crater has a prominent splatter pattern of bedrock shot up by the original impact blast.

Known as ejecta rays, these features are more often seen on other planets and moons with thin atmospheres.

The exact age of the Egyptian crater is still uncertain, the team reported this week in the online edition of the journal *Science*. Geologic evidence points to a relatively recent event, Folco said—although it's unlikely that any humans were around to witness the impact.

"During our field work we could see that some of the bedrock material ejected from the crater overlies prehistoric structures in the area," Folco said. "We know from literature that the human occupation of this region ended about 5,000 years ago, with the onset of hyperarid conditions. Therefore we think that the impact occurred afterwards."

(See "Exodus From Drying Sahara Gave Rise to Pharaohs, Study Says.")

Meteor Threat Greater Than Realized

If future meteors like the Egyptian rock are more likely to remain intact, their energy on impact would be more focused, causing greater damage, said John Spray, a crater expert with the University of New Brunswick who isn't connected to the study.

Still, the probability of such a meteor hitting something critical for society, such as a major city, would be reduced, because the falling rocks would not be as spread out.

"Overall, the threat from impacts is probably greater than people realize, but historically there is very little information on this, and we just have not been collecting data for all that long," Spray said. (See "100 Years After Tunguska, Earth Not Ready for Meteors.") "Our knowledge is very limited, so events such as these are quite important for helping us understand the frequency and nature of impacts that affect our planet."

Investigations into unintended acceleration should include engineers

Because of the electronic complexity of modern passenger vehicles, investigations into sudden, unintended acceleration should draw upon the expertise of a broad array of electrical, electronics and software engineers and computer professionals.

A February 2009 IEEE Spectrum article, "This Car Runs on Code," said that a modern premium-class automobile "probably contains close to 100 million lines of software code," and "all that software executes on 70 to 100 microprocessor-based electronic control units networked throughout the body of your car." By comparison, Boeing's 787 Dreamliner "requires about 6.5 million lines of code to operate its avionics and onboard support systems."

"The skilled engineers and technical professionals who design and evaluate modern vehicle systems bring not only knowledge and expertise from their specific disciplines, but also their experience and lessons learned from integrating technology into these vehicles," IEEE-USA President Evelyn Hirt said. "It goes beyond just having experience in a technology to understanding the complexity and application of that technology in its specific operating environment. This is frequently what is needed to assess why systems sometimes fail."

Faulty electronic throttle control systems have been cited as a possible cause of unintended vehicle acceleration incidents that have resulted in death and injury. The Toyota Motor Corp., the National Highway Traffic Safety Administration (NHTSA) and the National Academy of Sciences (NAS) National Research Council are each conducting separate studies into unintended acceleration.

NHTSA's study has enlisted "NASA engineers with expertise in areas such as computer controlled electronic systems, electromagnetic interference and software integrity." NAS' 12-member panel has, according to The Washington Post, three electronics experts and is planning to add three more. Its study will review unintended acceleration across all automotive manufacturers and investigate "electronic vehicle controls, human error, mechanical failure and interference with accelerator systems."

"There is no question that any effort to investigate these incidents will clearly benefit by including engineers with a firm grasp of the complex systems threaded through today's automobiles," said Doug Taggart, chair of the IEEE-USA Committee on Transportation and Aerospace Policy.

In a 6 April letter to Transportation Secretary Ray LaHood, IEEE-USA encouraged NHTSA to increase its number of electrical, electronics, computer and software engineers "to allow the agency perform the vital task of ensuring vehicle safety." On 24 May, NHTSA replied that it is "in the process of hiring a large number of engineers in response to the increased activities of the Agency."

Animals
Behind the Scenes: kasua

How Did Life Begin?

By David Terraso , Georgia Institute of Technology

posted: 23 July 2010 10:17 am ET

Scientists propose small molecules helped DNA and RNA first come together, allowing life to form. Here, Georgia Tech chemist Nicholas Hud in his laboratory. Credit: Georgia Institute of Technology.

Georgia Tech chemist Nicholas Hud in his laboratory.

Scientists propose small molecules helped DNA and RNA first come together, allowing life to form. Here, Georgia Tech chemist Nicholas Hud in his laboratory. Credit: Georgia Institute of Technology.

Nicholas Hud extracts a study sample in his laboratory

Nicholas Hud extracts a study sample in his laboratory. Credit: Georgia Institute of Technology.

This Behind the Scenes article was provided to LiveScience in partnership with the National Science Foundation.

Even before Charles Darwin proposed his theory of evolution in 1859, scientists the world over had been trying to understand how life got started. How did non-living molecules that covered the young Earth combine to form the very first life form?

Chemist Nicholas Hud has been working on this problem at the Georgia Institute of Technology for more than a decade. He and his students have discovered that small molecules could have acted as "molecular midwives" in helping the building blocks of life's genetic material form long chains, and may have assisted in selecting the base pairs of the DNA double helix.

The discovery is an important step in the effort to trace the evolution of life all the way to the very beginning, back to the earliest self-replicating molecules.

"We are working to uncover how molecules similar to RNA and DNA first appeared on Earth around 4 billion years ago," Hud said. "A few years ago, we proposed a theory that small, simple molecules acted as templates for the production of the first RNA-like molecules. Many of these small molecules, or molecular midwives, would have worked together to produce RNA by spontaneously mixing and assembling with the chemical building blocks of RNA."

In contemporary life, RNA is present in all cells and is responsible for transmitting genetic information from DNA to proteins. Many scientists believe that RNA, or something similar to RNA, was the first molecule on Earth to self-replicate and begin the process of evolution that led to more advanced forms of life, including human beings.

Recently, Hud and his team made a discovery that further advances their theory that certain molecules helped the first RNA and DNA molecules to form.

"We've found that the molecule ethidium can assist short polymers of nucleic acids, known as oligonucleotides, in forming longer polymers. Ethidium can also select the structure of the base pairs that hold together two strands of DNA."

One of the biggest problems in getting a polymer to form is that, as it grows, its two ends often react with each other instead of forming longer chains. The problem is known as strand cyclization. Hud and his research team discovered that by using a molecule that can bind in between two neighboring base pairs of DNA, known as an intercalator, they can bring short pieces of DNA and RNA together in a manner that helps them create much longer molecules.

"If you have the intercalator present, you can get polymers. With no intercalator, it doesn't work, it's that simple," Hud explained.

Hud and his team also tested how much influence a midwife molecule might have had on creating the Watson-Crick base pairs that make up the structure of DNA (A pairs with T, and G pairs with C). They found that the base pair matching was dependent on the midwife present during the reaction. Ethidium was most helpful for forming polymers with the specific Watson-Crick base pairs of DNA. Another molecule that they call aza3 made polymers in which each A base is paired with another A.

"In our experiment, we found that the midwife molecules we used had a direct effect on the kind of base pairs that formed," Hud said. "We're not saying that ethidium was the original midwife, but we've shown that the principle of a small molecule working as a midwife is sound."

"We're now searching for the identity of a molecule that could have helped make the first genetic polymers, a sort of 'unselfish' molecule that was not part of the first genetic polymers, but was critical to their formation," he added.

How Acquired Diseases Become Hereditary Illnesses

New understanding of epigenetics, or the molecular processes that control genes, show how it underlies hereditary forms of obesity and cancer

By JR Minkel

One of the primary goals of genetics over the past decade has been to understand human health and disease in terms of differences in DNA from person to person. But even a relatively straightforward trait such as height has resisted attempts to reduce it to a particular combination of genes. In light of this shortcoming, some investigators see room for an increased focus on an alternative explanation for heritable traits: epigenetics, the molecular processes that control a gene's potential to act. Evidence now suggests that epigenetics can lead to inherited forms of obesity and cancer.

The best-studied form of epigenetic regulation is methylation, the addition of clusters of atoms made of carbon and hydrogen (methyl groups) to DNA. Depending on where they are placed, methyl groups direct the cell to ignore any genes present in a stretch of DNA. During embryonic development, undifferentiated stem cells accumulate methyl groups and other epigenetic marks that funnel them into one of the three germ layers, each of which gives rise to a different set of adult tissues.

In 2008 the National Institutes of Health launched the \$190-million Roadmap Epigenomics Project with the goal of cataloguing the epigenetic marks in the major human cell types and tissues. The first results could come out later this year and confirm that different laboratories can get the same results from the same cells, says Arthur L. Beaudet of the Baylor College of Medicine, the project's data hub. "One couldn't automatically assume it would be so nice," he says.

Up to this point, the best way to study epigenetic effects has been a strain of mice known as agouti viable yellow. In these mice, a retrotransposon—a bit of mobile DNA—has inserted itself in a gene that controls fur color. Mice bearing the identical gene can be yellow or brown depending on the number of methyl groups along the retrotransposon.

Such methylation marks would normally be erased in the reproductive cells of an animal. But in 1999 a group led by geneticists at the University of Sydney in Australia discovered that methylation of the fur color genes persists in the female germ line, allowing it to be passed down to offspring like a change in the DNA.

Agouti viable yellow mice might have something to say about the human obesity epidemic. The animals have a tendency to overeat and become obese. In 2008 Robert A. Waterland, also at Baylor, discovered that this trait gets passed down and amplified from one generation of agouti to the next, so that "fatter mothers have fatter offspring," he says. He is investigating whether the effect can be explained in terms of methylation patterns in the hypothalamus, the part of the brain that regulates appetite.

Retrotransposons could lead to other epigenetic effects. In the early 2000s geneticist David Martin of Children's Hospital Oakland Research Institute in California reasoned that the silencing mechanism that keeps retrotransposons inactive might randomly shut down genes that are supposed to be left on. If the silencing occurred in a gene responsible for suppressing tumor formation, the result would appear the same as genetic mutations that predispose people to cancer.

Working with colleagues at St. Vincent's Hospital in Sydney, Martin identified two individuals who had the characteristics of hereditary nonpolyposis colorectal cancer, which is usually caused by a mutation that inactivates one of a person's two copies of the tumor suppressor gene MLH1, but who showed no signs of mutation. Instead the MLH1 of both was methylated in cells of the blood, hair follicles and inner cheek—all derived from different embryonic layers.

In Martin's view, the result strongly suggested that the patients had inherited the silenced gene from one of their parents, like the case with agouti mice. Although some researchers have suggested that a genetic mutation in the fertilized egg cell could be responsible for the methylation pattern, Martin says the simplest explanation is an inherited epimutation. "Nobody has been able to explain why these things aren't actually germ-line epimutations," he says.

If epimutations can happen, the same effect should turn up in other genes. Martin's colleague Catherine Suter of the Victor Chang Cardiac Research Institute in Sydney is studying whether melanoma patients have epimutations in genes associated with the cancer. It is also conceivable that epimutations could play a role in some cases of autism, Beaudet says.

Researchers agree they are just scratching the surface of understanding the role of epigenetics in health and disease. The NIH Roadmap Project should help by allowing them to compare models of disease with reference samples. In effect, "we're trying to figure out how we work," says epigenetics researcher Randy Jirtle of Duke University. "It's an amazingly huge project, and it'll never go away."

Camera app puts you in the footsteps of history

SUPERIMPOSING a historic photo on an up-to-date snap of the same scene is a neat way to bring history to life, as the website historypin.com demonstrates.

If you want to take a modern photo that will contrast effectively with its historical counterpart, though, you need to ensure it is taken from the same spot, and with the same zoom level. If you don't, the combined picture ends up looking disjointed, with roofs, walls and roads poorly matched.

Ensuring a modern photo is taken from the same position as its historic counterpart is tricky

Help is at hand, however, in the form of new software for digital cameras that helps people get their shot-framing spot on.



If these cobbles could speak (Image: Historypin.com/Mirror Pix)

Frédo Durand and Soonmin Bae at the Massachusetts Institute of Technology in Boston, with Aseem Agarwala of Adobe Systems in San Jose, California, turned to a technique called visual homing to come up with an answer (ACM Transactions On Graphics, DOI: 10.1145/1805964.1805968). Visual homing is used in robotics to send a machine to a precise location, such as a charging station.

The team's software runs on a laptop linked to a digital camera. The software compares the camera's view to a preloaded historical scene and provides instructions to adjust the camera's position and zoom to best match the scene. The laptop is a temporary measure, however: "We envision the tool running directly on the camera," the team says.

Iran launches nuclear fusion bid

Iran has launched a programme aimed at developing a nuclear fusion reactor - an ambition long-cherished by Western nations.

Asghar Sediqzadeh, head of the fusion research institute, said initial studies would last for two years, and a reactor would take 10 years to build.

Fusion is used in hydrogen bombs, but scientists have been unable to harness the energy created in such reactions. Iran is already under UN sanctions because of its nuclear activities.

The UN acted after Tehran ignored demands to halt its uranium-enrichment programme, amid fears in the West that the country is seeking atomic weapons.

Iran has always maintained its nuclear programme is intended only for peaceful purposes. At a ceremony to mark the beginning of the fusion project, Mr Sediqzadeh said 50 scientists would be working on the research. "Iran is one of the first countries to begin research in this field," he said. "We built one installation about 30 years ago. We had some delays in the past 10 years, [but] we can quickly make up for this time."

Ali Akbar Salehi, the head of the Atomic Energy Organisation of Iran, said the institute would have a budget of 80bn rials (£5.2m; \$8m). He said it would take 20 or 30 years for a fusion plant to become commercially viable.

Scientists across the world have been trying for decades to harness the energy released by fusion reactions.

They believe fusion would be far more efficient and environmentally friendly than current methods of power generation.

Despite small-scale success in laboratories, no-one has yet developed an effective way of channelling energy from a fusion reaction. The international community agreed to build a fusion facility in France in 2006. But costs have soared from initial estimates of 5bn euros (£4.2bn; \$6.5bn) to something closer to 15bn euros, and progress on construction has been slow.

Study Reconstructs Asia's Most Devastating Droughts Key to Understanding Monsoon and Climate's Impacts

The seasonal monsoon rains in Asia feed nearly half the world's population, and when the rains fail to come, people can go hungry, or worse. A new study of tree rings provides the most detailed record yet of at least four epic droughts that have shaken Asia over the last thousand years, from one that may have helped bring down China's Ming Dynasty in 1644, to another that caused tens of millions of people to starve to death in the late 1870s. The study, published this week in the journal Science, is expected not only to help historians understand how environment has affected the past, but to aid scientists trying to understand the potential for large-scale disruptions of weather in the face of changing climate.

See an audio slideshow of the tree-ring work in Asia

By sampling the wood of thousands of ancient trees across Asia, scientists at Columbia University's Lamont-Doherty Earth Observatory assembled an atlas of past droughts, gauging their relative severity across

vast expanses of time and space. “Global climate models fail to accurately simulate the Asian monsoon, and these limitations have hampered our ability to plan for future, potentially rapid and heretofore unexpected shifts in a warming world,” said Edward Cook, head of Lamont’s Tree Ring Lab, who led the study. “Reliable instrumental data goes back only until 1950. This reconstruction gives climate modelers an enormous dataset that may produce some deep insights into the causes of Asian monsoon variability.” There is some evidence that changes in the monsoon are driven at least in part by cyclical changes in sea-surface temperatures. Some scientists have speculated that warming global temperatures could alter these cycles and possibly make some of them more intense, but at this point there is no consensus on whether or how they might change.

For some tree species, rainfall determines the width of their annual growth rings, and these rings are what the scientists were able to read. The researchers spent more than 15 years traveling across Asia to locate trees old enough to provide long-term records. The hunt took them to more than 300 sites, from Siberia down to Indonesia and northern Australia, as far west as Pakistan and as far east as Japan. The project involved collaborations with numerous national governments, local villages and other university scientists. “It’s everything from low-land rain forests to high in the Himalayas,” said study coauthor Kevin Anchukaitis, a Lamont tree ring scientist. “You have a tremendous diversity of environment, climate influences and species.”

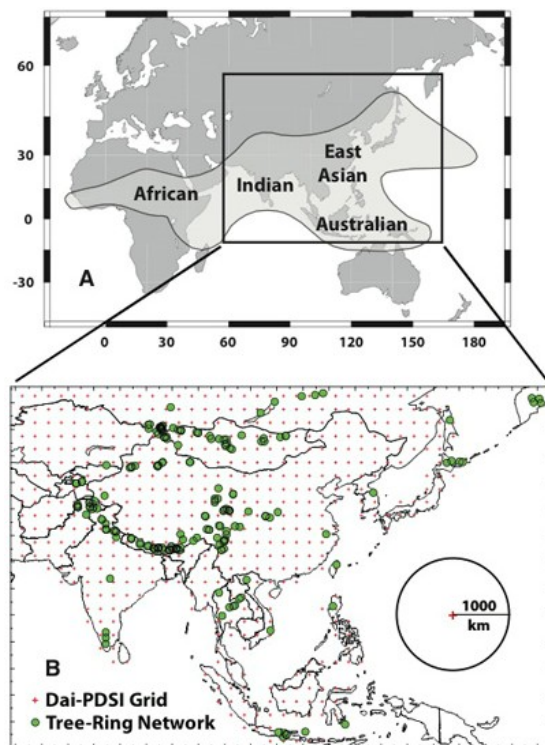
The tree-ring records in the study reveal at least four great droughts that are linked to catastrophic events in history. For starters, the study suggests that climate may have played a powerful role in the 1644 fall of China’s Ming dynasty. The tree rings provide additional evidence of a severe drought in China referenced in some historical texts as the worst in five centuries. This study narrows it down to a three-year period, 1638-1641. The drought was most sharply expressed in northeastern China, near Beijing, and is thought to have influenced peasant rebellions that hastened the demise of the Ming.

Another severe monsoon failure came in 1756-1768, coinciding with the collapse of kingdoms in what are now Vietnam, Myanmar and Thailand. The drought roiled political structures all the way to Siberia, and the tree rings also indicate that western India was severely affected. This drought is not documented in historical records; scientists first identified it in teak rings from Thailand, and later in Vietnamese cypress trees. Some historians have speculated that climate must have played a role for such sweeping political changes to have happened simultaneously; fragmentary accounts suggest that dry periods may have been punctuated with devastating floods. The study appears to provide an explanation for the so-called “strange parallels” that Victor Lieberman, an historian at the University of Michigan, has spent his career studying. “It provides confirmation that there are very strong climate links between monsoon regimes in India, Southeast Asia and southern China,” said Lieberman in an interview.

Then, the so-called East India drought hit in 1790-1796. This one appears to have been felt worldwide, spreading civil unrest and socioeconomic turmoil. For instance, in Mexico, water levels at Lake Pátzcuaro fell so much they gave rise to ownership disputes over the land that emerged. In Europe, drought led to crop failures that preceded the French Revolution. Famines hit India.

Perhaps the worst drought, the scientists found, was the Victorian-era “Great Drought” of 1876-1878. The effects were felt across the tropics; by some estimates, resulting famines killed up to 30 million people. According to the tree-ring evidence, the effects were especially acute in India, but extended as far away as China and present-day Indonesia. Colonial-era policies left regional societies ill-equipped to deal with the drought’s consequences, as historian Mike Davis details in his book *Late Victorian Holocausts*. Famine and cholera outbreaks at this time in colonial Vietnam fueled a peasant revolt against the French.

Monsoon rains touch a huge part of the world. Lamont scientists crossed most of Asia to sample sites to reconstruct past droughts.



Monsoon rains touch a huge part of the world. Lamont scientists crossed most of Asia to sample sites (green dots) to reconstruct past droughts.

The study follows a related report last month by the Lamont tree-ring team suggesting that dramatic variations in the monsoon may have influenced the collapse of the ancient Khmer civilization at Angkor nearly 600 years ago, in what is now Cambodia. That paper, appearing in the *Proceedings of the National Academy of Sciences*, showed evidence of a mega-drought in the wider region around Angkor from the 1340s to the 1360s,

followed by a more severe but shorter drought from the 1400s to 1420s. The droughts were interspersed with severe flooding, and the kingdom collapsed shortly after. The scientist who led that study, Brendan Buckley, coauthored the present drought atlas.

Scientists aren't exactly sure how factors such as volcanic eruptions, greenhouse gases and variations in solar output combine to drive the many variations in the monsoon over the long term. Over shorter time periods, variations seem to be more closely linked to the El Niño-Southern Oscillation (ENSO), the warming and cooling of the tropical Pacific atmosphere-ocean system. Separate studies suggest that El Niño, the warm phase of ENSO, often coincides with a weak monsoon and droughts; it also seems linked to weather changes in Africa and parts of South America. The deadly 1876-1878 drought coincided with one of the most extreme El Niños of the last 150 years. However, the parallels are not perfect, so other factors may come into play at different times, including changes in snow cover over Asia and cycles of sea-surface temperature in the Indian Ocean. There is intense interest in how El Niño and other phenomena may be affected by a warming climate, and how monsoon extremes may affect the growing populations that depend on the rains. Southern China is currently suffering its worst drought in 80 to 100 years, bringing not only water shortages, but tensions with Southeast Asian nations downstream of its watersheds.

Data from the drought atlas is already providing information on particular regions, say the scientists. Using the Indonesia tree ring records, for example, Lamont scientist and study coauthor Rosanne D'Arrigo has reconstructed stream flow in Java's Citarum river basin, a region that waters much of Indonesia's rice. In a recent study in the journal *Climate Dynamics*, D'Arrigo found a close link between El Niños and weak monsoon rains or drought in Indonesia over the last 250 years.

The atlas is valuable to monsoon forecasters because the record is long enough and the spatial areas detailed enough that modelers can pick out short-term and long-term patterns, said Bin Wang, a meteorologist and monsoon modeler at the University of Hawaii who was not involved in the study. "It is extremely valuable for validating climate models' simulation and understanding their origins in terms of model physics," he said.

Sneaky dogs take food quietly to avoid getting caught

LIKE children with their hands in the cookie jar, dogs steal food quietly to make sure they don't get caught. The finding adds to evidence that dogs can work out what others are thinking.

Shannon Kunday of Hood College in Frederick, Maryland, and colleagues, gave 40 dogs, which had previously been trained not to eat food left on a plate, a chance to take food from inside two containers. Both containers were fitted with bells, but on one container the bells were muted.

When someone was watching, the dogs took food from both containers equally. But if the watcher looked away, for instance by putting their head between their legs, the dogs went for the silent container. This suggests they knew they could get a meal without the watcher hearing them (*Applied Animal Behaviour Science*, vol 126, p 45). Kunday says her results back up other evidence that dogs can represent for themselves how others perceive their actions. For example, previous studies had found that dogs are more likely to take food when people are not watching them.

Marc Bekoff at the University of Colorado at Boulder says the findings are more proof that humans' mental abilities are not unique. "Great apes do amazing things, but so do other animals," he says.

Light and Moderate Physical Activity Reduces the Risk of Early Death, Study Finds

ScienceDaily — A new study by researchers from the London School of Hygiene and Tropical Medicine (LSHTM), Cambridge University and the Karolinska Institute in Sweden has found that even light or moderate intensity physical activity, such as walking or cycling, can substantially reduced the risk of early death.

The study, published by the *International Journal of Epidemiology*, combined the results from the largest studies around the world on the health impact of light and moderate intensity physical activity. It showed that the largest health benefits from light or moderate activity (such as walking and cycling) were in people who do hardly any physical activity at all. Although more activity is better -- the benefits of even a small amount of physical activity are very large in the least physically active.

The good news from this study is that you don't have to be an exercise freak to benefit from physical activity. Just achieving the recommended levels of physical activity (equivalent to 30 minutes daily of moderate intensity activity on 5 days a week) reduces the risk of death by 19% [95%confidence interval 15% to 24%], while 7 hours per week of moderate activity (compared with no activity) reduces the risk of death by 24% (95% CI 19% to 29%).

Lead researcher, James Woodcock said, "This research confirms that is not just exercising hard that is good for you but even moderate everyday activities, like walking and cycling, can have major health benefits. Just walking to the shops or walking the children to school can lengthen your life -- as well as bringing other benefits for well-being and the environment."

Morning Test Helps Doctors Save Kidneys

ScienceDaily – A morning urine test is superior to all other tests for detecting declining kidney performance in patients with diabetic kidney disease, according to a study appearing in an upcoming issue of the *Journal of the American Society Nephrology (JASN)*. The results suggest that clinicians should monitor kidney function by measuring the albumin:creatinine ratio from a first morning urine sample.

Individuals with kidney dysfunction often excrete excess protein in the urine, a condition called proteinuria. Screening for proteinuria may help identify people at risk for kidney disease progression, but uncertainties persist as to how urine should be collected and which specific urinary proteins should be measured. Because the different screening methods available may confuse clinicians, it may hamper the use of proteinuria to manage patients with kidney disease.

Hiddo Lambers Heerspink, PharmD, PhD (University Medical Center Groningen, in the Netherlands) and his colleagues assessed and compared the ability of various proteinuria measures, including proteinuria versus albuminuria and 24-hours versus early morning sampling, to predict worsening kidney problems. Albuminuria, a large component of proteinuria, is more specific than total proteinuria and is defined as an excess amount of albumin in the urine. ***Four measures were compared:***

- * urinary protein excretion from a 24-hour urine collection,
- * urinary albumin excretion from a 24-hour urine collection,
- * urinary albumin concentration from a first morning urine sample, and
- * albumin:creatinine ratio from a first morning urine sample (the amount of albumin in the urine sample normalized by the amount of creatinine).

The investigators conducted their analysis in 701 patients with type 2 diabetes and kidney disease who were participating in the Reduction in Endpoints in Non Insulin Dependent Diabetes Mellitus with the Angiotensin-II Antagonist Losartan (RENAAL) trial. They defined worsening kidney function as the development of end-stage renal disease or a doubling of blood levels of creatinine (a breakdown product of muscle creatine). Kidney dysfunction diminishes the ability to filter creatinine, resulting in a rise in blood creatinine levels.

Dr. Lambers Heerspink and his team found that measuring the albumin:creatinine ratio in a first morning urine sample was the superior method to predict kidney problems in patients with type 2 diabetes and kidney disease. "From a clinical point of view, these results are very important, because they imply that collection of first morning voids, which is clearly more convenient than collecting a 24-hour urine, can be used for assessment of proteinuria," Dr. Lambers Heerspink said. The authors noted that standardizing proteinuria measures will improve methods for detecting and monitoring kidney disease.

In an accompanying editorial, Bryan Kestenbaum, MD and Ian de Boer, MD (University of Washington, Seattle) stated that "given data from this study and the considerable patient effort required for a 24-hour urine collection, we agree with the authors that the first morning albumin:creatinine ratio is in general the logical choice for quantifying proteinuria in clinical practice."

The RENAAL study was sponsored by Merck & Co., Inc. Study co-authors include Ron Gansevoort, MD, PhD, Dick de Zeeuw, MD, PhD (University Medical Center Groningen); Barry Brenner, MD (Brigham and Women's Hospital and Harvard School of Medicine); Mark Cooper, MD PhD (Baker IDI Heart and Diabetes Research Institute, in Melbourne, Australia); Hans Henrik Parving MD, PhD (University Hospital of Copenhagen, in Denmark); and Shahnaz Shahinfar, MD (Children's Hospital of Philadelphia).