Infoteca's E-Journal

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Emily Doesn't Care If You Listen

By Noah Stern Weber

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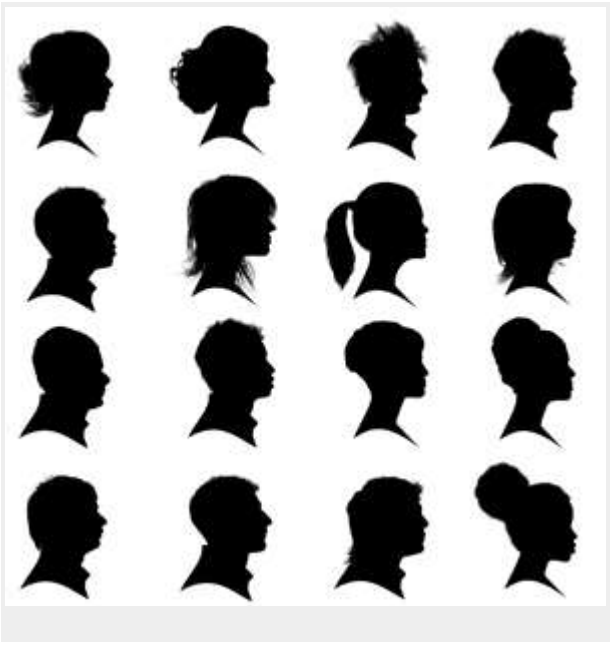


"Cope remembered that Bach wasn't a machine—once in a while, he broke his rules for the sake of aesthetics. The program didn't break any rules; Cope hadn't asked it to."

—Ryan Blitstein, "Triumph of the Cyborg Composer," Miller-McCune, February 22, 2010.

Technology evolves at such a fast pace that it is often difficult to discuss a new innovation critically without fearing that the argument will be anachronistic before the discussion is even complete. Yet we must consider the software and hardware around us as they relate directly to the moment we live in, for any attempts at trying to write about the evolution or limitations of the technology of the future is a folly. To date, there is very little by way of critical analysis of David Cope's computer programs "Emmy" and "Emily Howell" outside of the relatively esoteric field of research into artificial intelligence, and thus I hope to offer one as best as 2011 will allow.

Emmy (a play on EMI—Experiments in Musical Intelligence) is software, capable of creating original music when given certain parameters. If Bach's six Brandenburg Concerti are uploaded into the program, a new work "in the style" of the Concerti will appear. If Mahler's Ninth Symphony, Schoenberg's *Verklärte Nacht*, and Zemlinsky's Lyric Symphony are synthesized by Emmy, a work of distinctly late 19th-century Vienna will be produced. As a strong proponent of computer sciences as they relate to music, Cope felt the desire to go further with artificially intelligent composition and put aside the program that merely synthesized the works of previous composers to create a new, dynamic platform, "Emily Howell." Emily only uses musical

sources produced by Emmy, which include everything from Navajo Songs to Mahler, and (officially) the only living composer whose work is present in the database is Cope's.

The implications of these programs are tremendous. For musicians and audiences alike, the progress and even nature of music could be fundamentally changed. If a computer program could create new music with the push of a button, customizable to anyone's taste and without distinct intellectual copyright issues, it would revolutionize the way music is produced and consumed in everyday life.

Yet there are technical, philosophical, and practical issues which must be considered when weighing the value of Emmy and Emily Howell in society. How does Emily potentially affect music from the perspectives of composers, performers, computer programmers, classical music fans, and the general public? Does Emily live up to Cope's claims regarding Howell's capacity?

What is Music? The answer might seem obvious, but it is important to define what music is before it can properly be discussed. Leonard Bernstein argued in his 1973 Norton Lectures (later titled *The Unanswered Question*) that based upon Noam Chomsky's analysis of languages, syntax, and grammar, music functions as a language. By extension, it suggests that music is just a root—as the Phoenician and Cyrillic alphabets offer basic structures for languages to be built, so can music be parsed in various ways to offer many languages. Thus music is not a universal language. Contrary to romantic notions that music transcends nation, culture, and status, any Western listener who has ever sat down to traditional Tibetan chants can attest that what one culture considers sacred, another would consider cacophonous. Tritones (and their surrounding microtones) are considered harmonious in many of these musical languages, while Western classical music referred to the tritone as "the Devil's Interval" for a significant period of time—not only unpleasant but, by association, immoral.

Languages also inherently evolve over time; while Chaucer wrote in "English," it is virtually unintelligible to the modern speaker. A mid-point can be seen in Shakespeare—certainly understandable to an English speaker, but syntactically far removed from our present language. Each musical language evolves as well. During the Renaissance, Western classical music revolved around modal harmonies, with the Ionian and Aeolian (major and minor) scales rarely used. From the Baroque until midway through the Romantic Period, Ionian and Aeolian (tonal) harmonies were the principal musical dialects. Toward the end of the Romantic period, tonal harmony began to disintegrate and a slew of new harmonic structures were used. Music then can be said not only to function as a language, but to evolve as one as well. While not immediately capable of relaying concrete ideas (i.e. "Go take out the garbage!"), it is nonetheless a form of communication: A poetic communication, with grammatical and syntactical rules guiding its usage and comprehensibility as the language evolves.

Ultimately, the discussion involves intention. A language is a collection of sounds, organized into roots, expanded into words, and then governed by grammar to take otherwise incoherent tones and give them meaning. Neither "hjew wejklf jjeih" nor "anatomical shelf run quarry" conveys anything, because they are not following the basic rules of the language used to write this essay. Is a birdcall music or literal language? To a bird, it communicates a specific idea (danger, mating, etc.) and thus should be considered a literal language. The average human lacks the ability to understand the intended message, yet we can reconceive it and render it into a musical concept. A powerful and congruent example of this can be seen in Olivier Messiaen's fascination with birds and his usage of their songs in music and ornithography. He spent a significant portion of his life cataloging birdcalls, using musical notation only as a medium for documentation. Yet in the composition of his *Quartet for the End of Time*, he utilizes birdcalls interpretively, using the free harmonic language of the nightingale to conjure an image of an Eden-like heaven. In doing so, he removes the literal meaning of the birdcalls for the picture he is painting in tones—and it becomes music.

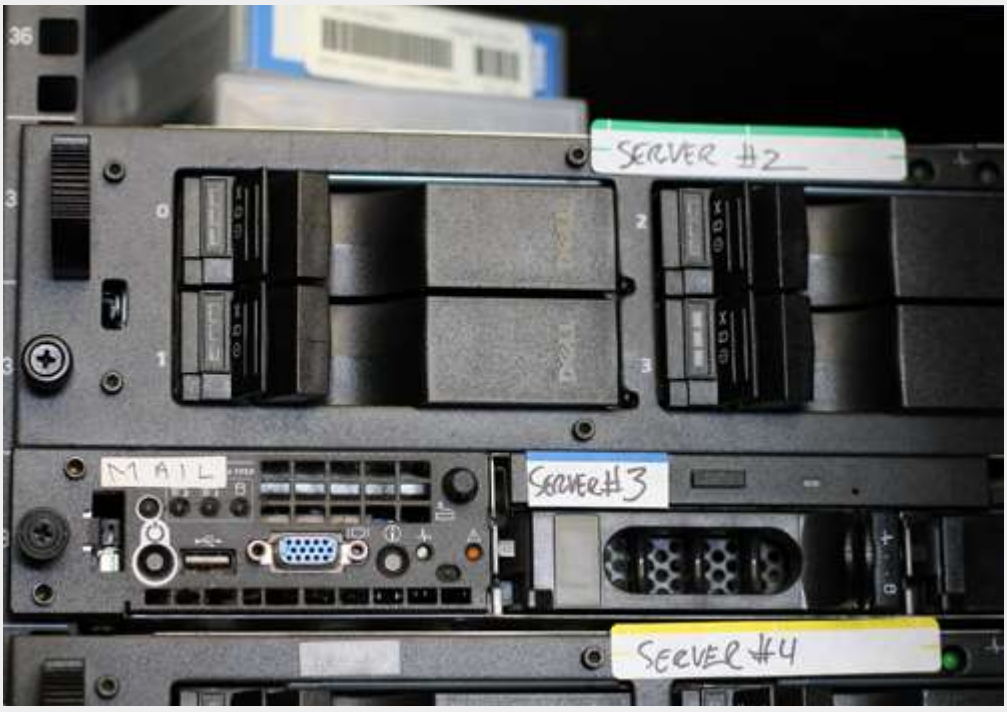
As we relate this back to computers attempting to communicate, why aren't there any computers creating works of literature, either in the style of a specific author or in their own, unique style? Would the general public want to consume a book written by a computer? Would it have any substance?

At the Rensselaer Polytechnic Institute, scientists have made a noble attempt. Their program, "Brutus," can produce simple stories, based upon certain paradigms of contemporary struggle and conflict. The researchers state:

We use Brutus.1 in support of our philosophy of *Weak* Artificial Intelligence—basically, the view that computers will never be genuinely conscious, but computers *can* be cleverly programmed to "appear" to be, in this case, literarily creative.

(—From the website for Brutus;
examples of the literary output can also be read there.)

While it is fascinating to observe a computer able to use algorithms to analyze the basic elements of human interaction and mimic them, the end result is, at least at this time in computer development, lacking in the originality of insight into a human issue. A computer can only generate responses based upon previously programmed ideas. This "*Weak* Artificial Intelligence" can only mimic the process of learning—its ability to learn is confined to the parameters it already understands. Profound literature is created through a unique perspective, conveyed through language in a way that resonates with readers. By definition, a computer cannot have a unique perspective or original idea until it is able to achieve *true* artificial intelligence—specifically, self-awareness.



So why then has Emily Howell gained a certain amount of popular acceptance through live performances and record sales while her literary counterpart remains an academic novelty?

Music is mystical. Or more appropriately, its composition is romanticized. Most people "compose" text on a daily basis, whether for mundane or creative purposes. Comparatively few compose music so prolifically. Improvisational music can be viewed as the one field of composition that captures the same freedom and immediacy in the use of a musical language, but it requires a certain amount of training, both in the grammar of a musical language and in the technical execution required to perform it on an instrument. So the composition of music is left to "talented" or "gifted" individuals, while the majority of society remains content simply to consume the products. This is where the Turing Test becomes a significant factor.

In 1950, the English mathematician and computer scientist Alan Turing proposed a test for determining true artificial intelligence. It proceeds as follows: a human judge engages in a natural language conversation with one human and one machine, each of which tries to appear human. All participants are placed in isolated locations. If the judge cannot reliably tell the machine from the human, the machine is said to have passed the test. In order to test the machine's intelligence rather than its ability to render words into audio, the conversation is limited to a text-only channel such as a computer keyboard and screen. To date, no computer has won the Loebner Grand Prize, an ongoing challenge for a computer to pass the Turing Test. (There is an annual prize for the computer "which is most indistinguishable from a human," thus attempts are regularly made.)

The most popular story about Emily Howell suggests that she does indeed pass the Turing Test. A 2009 article by Murad Ahmed published in *The Times* (London), offers an un-cited and un-attributed anecdote from Cope about a professor who came to him a break in the middle of a lecture performance at UC Santa Cruz, where both professors teach. After the piece was played, the "professor came to me and said this was one of the most beautiful pieces he'd heard in a long time." Then, after listening to the lecture and learning that it was written by a computer, he was reported to have said, "From the minute it started I could tell it was computer-composed. It has no guts, no emotion, no soul."

Cope's anecdote extends the parameters of the Turing Test to music, offers that Emily has passed it, and implies that academia is reluctant to acknowledge his brilliant discovery. Yet looking more carefully at his statement, a serious question of judgment arises. Who was this professor? The reader is lead to believe that he is a professor of music—otherwise why mention his status within the school. More importantly, why would this "professor," who presumably knew Cope's work, go to a lecture recital, feel inclined to make such strong statements in support of the work, only to make a contradictory statement, insulting Cope's achievement, shortly after?

There is no question that Cope, in devoting himself to his science, has anthropomorphized Emily and is fighting to gain recognition for her[1], but to what extent? Music is a poetic, interpretive language, not a literal one, thus the standards for the Turing Test cannot be directly applied. Many works by living composers, such as Pierre Boulez's *Structures 1a*, would more readily be accepted as the music of computers than Howell's, but the intention behind *Structures 1a* was to give way to an intricately conceived, emotionless canvas. As an academic deeply involved in the world of artificial intelligence (he has written seven books and twenty articles on the subject of music as it relates to computers, with three of the books and nine of the articles dealing specifically with AI, as well as a creator of Artificial Intelligence Poetry Program), Cope's attempts to suggest that computer music can be judged by the Turing Test don't adequately consider the basic elements of the test as they relate to musical languages, as well as the limitations of the linguistic test itself.[2]

In many ways, this conversation is directed towards the producers of music—both the composers and the

performers who devote their lives to the creation of music. Emily Howell is an extension of the iTunes "Genius Function," and the "Personalized Recommendations" function utilized by Netflix, Amazon.com, Pandora, and a host of other media outlets that try to predict human desires to increase sales. Most consumers of this media appreciate the "Personalized" results, as it offers them suggestions as to what they will want to purchase next, giving them something new without straying too far from what they already know. The popular dating site eHarmony.com acknowledges the limitations of its algorithm, and after a 30-minute personality test, informs as many as twenty percent of its potential clients that they do not fall into a specific category, and are thus "unmatchable."[3] While this might be disheartening to a single individual in search of love, it suggests that human preferences cannot be simply reduced to a series of parameters.

As producers of music, it is important to understand the limitations of assuming that groupings or categories of sounds will elicit specific emotions. While a minor key often implies a more somber mood in Western classical music (obviously with exceptions), the effective usage of a key is different from composer to composer and piece to piece. At this moment, artificial intelligence cannot understand the subtle gradients, or their reception without a human intermediary.

Emily Howell has proved effective at mimicking a composer fairly well. The entire project was created when David Cope, struggling to complete an opera commission, designed a program that understood his music idioms, tendencies, and syntax, and then produced new material in his style. He used this basic material as a guideline to complete the opera. After this, Cope began to expand the parameters, inputting works of other composers into Emmy, trying to create a program that would offer something as authentic as the original. The idea itself was not new—Fritz Kreisler performed many "lost" works of the baroque era, only to later reveal that they were of his own pen, and Remo Giazotto used the bombing of Dresden to "uncover" several works "by Albinoni," most famously the Adagio in G Minor. Yet there is a notable difference: while Kreisler and Giazotto were able to pass off the works as originals because of their fame, closer analysis of the works show distinct signs of musical influences other than the supposed original composer. Emmy's output proved to be mediocre examples of the original composer, with no uncharacteristic elements, but also none of the "brilliance." In the section of his website devoted to "Experiments in Musical Intelligence," Cope describes Emmy's process as:

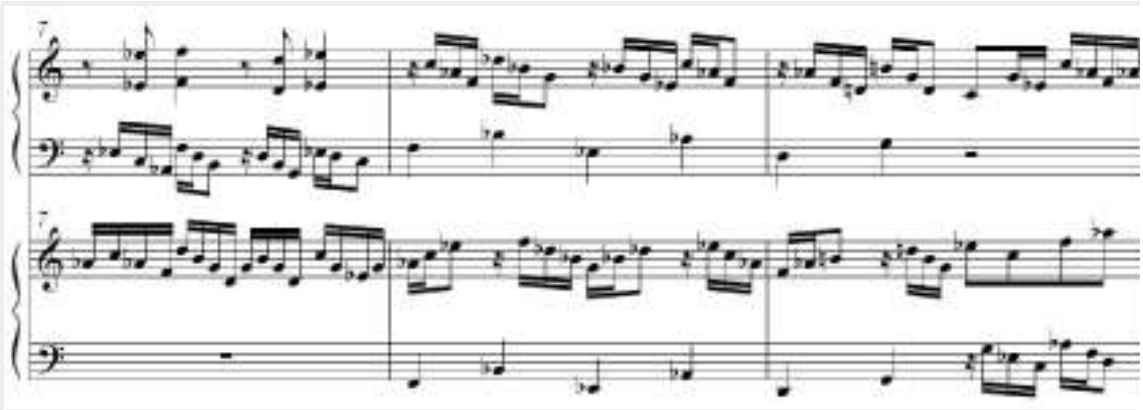
(1) deconstruction (analyze and separate into parts)
(2) signatures (commonality - retain that which signifies style)
(3) compatibility (recombinancy - recombine into new works)
This process created a composite of the functional norms, and by his own admission, the results were rather uninspiring.

In "Creative Writers and Daydreaming," Freud described the creative process as "the suspension of rational principles." A computer can create an infinite number of random possibilities, but the concept of suspended rationality has yet to be attainted by a computer. As Cope explains in "Experiments in Musical Intelligence," it was the lack of "errors," or intentional breaking of the rules, that made Emmy's work plastic. As nuanced as the programming can be, the difference between irrational and random (or intentional breaking of the rules for an aesthetic reason versus arbitrary straying because a certain amount of unpredictability is required) is what separates creation from amalgamation.

There is no question that musical borrowing and referential passages play a significant role in composition. The Western classical tradition teaches composition through the study of the canon. Nadia Boulanger, the famous compositional pedagogue, explored a new composer each week with her class, analyzing pieces of the composer and then requiring her students to write a piece in that composer's style. Yet, as Igor Stravinsky famously remarked, "A bad composer borrows, a good composer steals." This suggests that to be influenced by another, one cannot simply break down the process and imitate, but must incorporate it into their own

personal language. Boulanger's methodology taught her students to understand the creative process of historical figures to enrich their vocabulary—teaching them grammar that they would then mold into their own voices—as seen in the multifarious careers of her pupils (Aaron Copland, Roy Harris, Virgil Thomson, Elliott Carter, Quincy Jones, Philip Glass, etc.). But Emily cannot generate her own style, because, as limited by a lack of self, she cannot interpret the works of others; she can only analyze them.[4]

There is something to be said for the sheer technical achievement that is Emily Howell. In a way, she is a work of art. From the technical perspective, she is on par with the most advanced forms of artificial intelligence currently in production, and more so because her product can mimic "human" music to the extent that listeners don't assume that it is computer music. Yet having had the opportunity to review two scores (of six total works) by Emily Howell and compare them to the official recordings supervised by David Cope, I stumbled upon a fascinating issue: the music used for the recording has been edited from that which was originally produced by Emily Howell. Specifically in *Land of Stone*, Opus 3, passages are modified, instruments and parts are added and rhythms, octaves, and dynamics are changed. Also, comparing the score markings in *Land of Stone* to *From Darkness, Light*, Opus 1, there are significant differences in the quantity of markings. While *From Darkness, Light* is very loosely annotated (in the style of Bach, as seen below), the later work, for a chamber orchestra, is mired by articulations, stylistic directions and various dynamic and tempo markings.



From Darkness, Light, ii. Fugue, measures 7-9

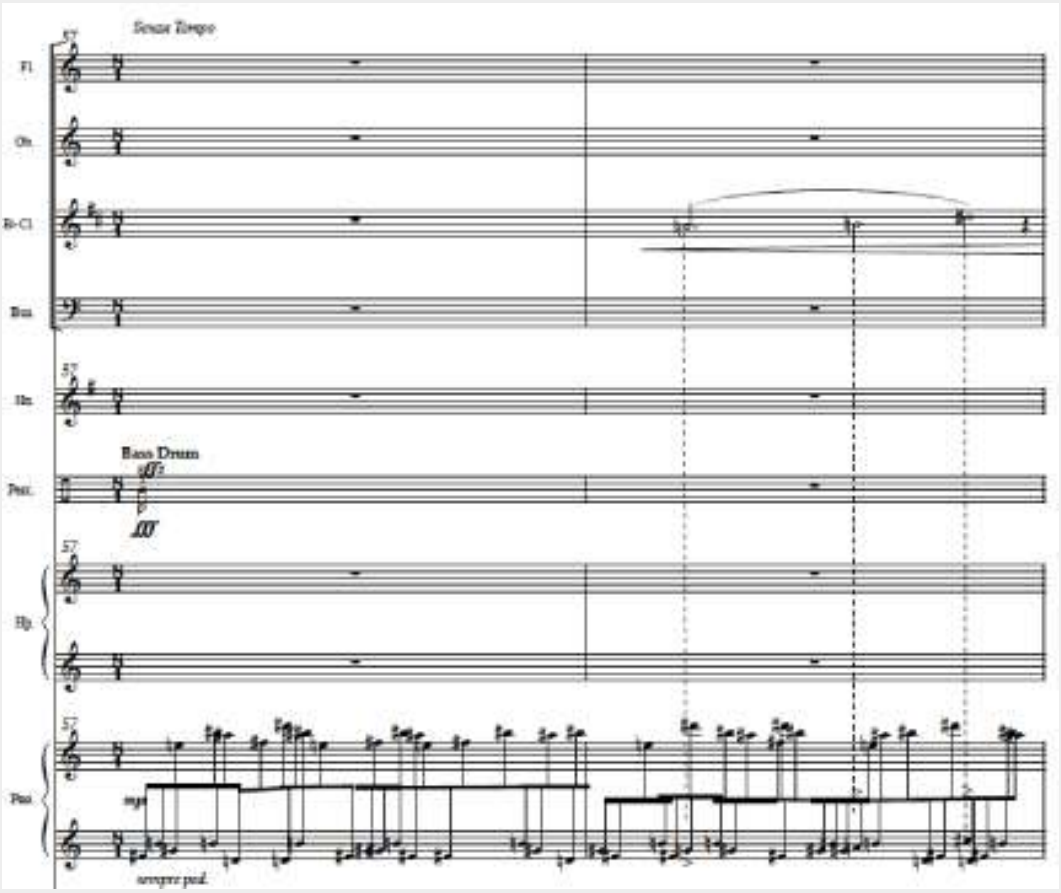
I have broken down the changes into four categories: additions or subtractions; modifications (excluding passages that could conceivably be attributed to player error—in the last major section, from measures 165-263, the rhythms become complex and the accuracy of the recording suffers in this section, thus only pitch, register, and additions are considered there); errors (i.e. passages that are impossible or that contain incoherent markings); and passages that can reasonably be assumed to have stylistic markings not originating from the computer. There were at least 12 additions or subtractions, 29 modifications, 68 edits, and 17 errors in the 275 measures that comprise this piece.[5]

This lead me to contact Nicole Paiement, the music director of Ensemble Parallèle, the group that recorded *Land of Stone* for Cope's commercial recording. She confirmed much of what I had inferred regarding the active editing of the work. When asked if and how the piece changed, she said:

There was more of an evolution of the piece prior to the performance. As we started to work on the piece we adapted things that were not working as well… So it was as if [Cope] sort of became the computer-composer.

So he would listen, and most times he agreed, and at times he said, "we would keep that," but generally speaking David was very agreeable to doing the changes that would make the piece a better piece.

Where then does this leave Emily Howell's work? Aside from its inability to properly grasp the capacity of the instruments in the orchestra (i.e. asking a harp to crescendo and decrescendo with a single struck note, as in measures 12-13, writing out of the range of an instrument, such as the D5 written for the contrabass in measure 185), it is clear that Cope felt free to edit and modify "Emily's" work as he saw it fit. In most every case of an addition (i.e. mm. 65-85, the addition of the harp and glockenspiel outlining the suggested harmonies in the bassoon and clarinet, various examples of instruments moved 8va or 8vb because the range it was written in was not conducive to the mood, the flute introduced a measure before each of the "bell-like" sections, measures 138, 149, 154), there is a good musical reasoning for it. Furthermore, specialized stylistic additions turn theoretical structures into quasi-lyrical passages, such as the addition of *Senza Tempo* at measure 57, allowing the pianist to freely explore a somewhat random twelve-tone quasi-aggregate[6] phrase:



Land of Stone, Measures 57-58

So while Cope states in his program notes for *Land of Stone* that:

My role with Emily is to provoke her to compose good music, and once composed, act as her impresario—her agent —to obtain performances, recordings, and so on…

It is clear that he is integral to the compositional process. Despite his assertion that Emily Howell produces "good music" on her own, the interference with the program's output, both through his editing and Paiement's critiques, suggests that his claim of computer-composed music is still a distant vision.

Emily is a testament to the nature of music: by parsing compositions down to their bare elements, she offers definitive proof of music as a language. She can rapidly produce composite works, changing the way *à la carte* music is created for daily consumption, but let's not confuse these experiments in mass-produced Muzak with human attempts to create art.

As this discussion moves toward the perspective of the audience member, an important question arises: Do people need a relationship with a composer?

To illustrate this question regarding audiences and their expectations, I offer the prostitute metaphor. A prostitute is paid for by friends of a particular person without his knowledge. She is instructed to approach him at a party as if she were genuinely interested in him. The man cannot believe his good fortune—she is the paradigm of what a woman should be. She is beautiful, intelligent, and finds him witty and humorous. The man brings her home and wakes in the morning to find her gone. Disheartened, he calls his closest friend to recount his brief encounter with love, only to be told that all of his perceptions were ill-conceived. He made the assumption that when she approached him at the party, she found him attractive. He then further assumed that she was enjoying the time spent with him as they conversed and flirted. As he went to sleep that night, he most certainly assumed that she would at least be there the next morning.

Does this man's discovery that his conception of the relationship was based on a lie change his appreciation of the event? I believe he might be forced to see it as nothing more than a mechanical act, destroying his concept of the presumed relationship. There is an argument that music is nothing more than notes on a page. In theory, it is. It can sit in a cabinet for centuries and be as irrelevant as the dust that collects upon it. Yet once it is performed, there are inherent implications; including the assumption that this is an interaction between a composer and a listener. Only Emmy and Emily Howell can truly be impartial to music, breaking it down to its elemental roots without any response to the composite sound. As human beings, we have been exposed to music, and "understand" the language (although different dialects and varying degrees of "literacy" and natural sensitivity exist).

Another issue to take into account when considering the public: Who owns Emily Howell's intellectual property rights? First, the issue of her sources needs to be discussed. Cope says of her musical sources:

In January of 2003, I retired my Experiments in Musical Intelligence program (Emmy).

My reasons were many, but mostly this retirement resulted from my desire to get on with my life. I had for years envisioned a new program which, unlike Emmy, included many aspects of computational creativity that Emmy did not include (I discuss this in depth in my book Computer Models of Musical Creativity, MIT Press, 2005). I call this new program Emily Howell.

Interestingly, the database for Emily Howell consists mainly of music composed by Emmy, thus linking this new program with my previous work in rather explicit and intimate ways. Emily's style, a hybrid of the many styles which Emmy emulated during her twenty-year career, has fits and starts of Ivesian-sounding pastiches. My goal involves her creating a completely new style — a composite of those that most effectively complement one another.[7]
Emmy was intended solely to create additional material in the style of a previous composer, so her musical sources were (officially) the great composers of the past, as well as works by Cope. Yet theoretically, any composer could be plugged into the program to produce something similar. Assuming an orchestra wanted to

perform a piece by Copland, but didn't want to pay the rental fees, they could plug several pieces of Copland into the program and title the work *Hommage à Copland*. Unscrupulous composers could freely exploit works by their colleagues, using Emily Howell to create a work using sources from several pieces still under copyright. Or it could cheapen contemporary composition altogether, as Cope freely suggests in his original reasoning for creating Emmy—writer's block.

These aspects should be troubling to anyone in the field of music. If the cost of producing "new" music through Emily is exponentially lower and the product created faster than through traditional composition, there is no question that it would be widely used. Yet the previously established inability of Emily to create truly original work will prevent music from evolving. Living composers, already struggling to exist outside of academia, simply won't have the ability to compete, and Milton Babbitt's vision of composition as a science completely removed from the real world, summarized in his article "Who Cares if You Listen?,"[8] will be a reality.

Something which I had initially hope to explore further was Emily Howell's ability to set text. Specifically because Cope said he originally used Emmy to complete an opera, and one of Emily Howell's five works is *From the Willow's Keep*, Op. 4, I requested this score from Cope with the hopes of offering a critical analysis, but was only provided with *Land of Stone* and *From Darkness, Light*. At the same time, there is no documented text in the English language with the phrase "From the Willow's Keep," so the text for his piece may have been produced by Cope's "Poet Program."[9] As it relates to contemporary popular composition, the setting of text would be immensely important. Cope alluded to a "well-known pop group" inquiring about utilizing Emily Howell,[10] thus the practical applications in popular music must be considered. "Emily Howell is adaptable and egolessly self-modifying in her ability to respond to audience criticism."[11] This is an audacious claim, both as it relates to classical and popular music. First, how is Emily able to evaluate and respond to audience criticism? Is she evaluating based upon "hoots and hollers?" Can she distinguish between a hoot and a holler? Presumably, she is responding using a decibel meter—but this cannot really compare a room full of jeers to a room full of cheers (or more likely a combination of both). Possibly in the future, each member of the audience will be connected to a device measuring serotonin levels, and a "Matrix"-esque construction of the auditory experience will be a reality. Furthermore, since standard concert etiquette suggests that audiences only show signs of approval or disapproval at the end of a piece, how exactly does this egoless self-modification occur? How does she "realize" that a certain note, passage, or even section was disliked? This again is a romanticized notion of Emily functioning without the help of Cope. Yet going further, her egoless state means she fundamentally has no artistic integrity. Right now she produces "pretty" music. Warren Riddle, editor for the popular tech magazine *Switched*, ended his optimistic article on Cope's work with the bombastic tirade:

The current offerings (of Emily Howell) may be limited, but they're definitely more appealing than the soulless, conformist tripe that so-called "humans" are currently regurgitating at an alarming rate.
Is there nothing to stop Emily Howell from churning out "soulless, conformist tripe"? She is nothing but a computer program, and can be utilized in a myriad of ways.

Regarding the practical application of Emily Howell to popular music, it could be the device that ultimately ends professional music on any level. *Guitar Hero*, *Rock Band*, and any number of other music simulation games offer people with no prerequisite capacity for music the opportunity to feel like they are creating it. If Emily Howell were widely distributed, anyone could mix their favorite five songs together to create a composite they would feel is theirs. In theory it is "music for the masses," no holds barred, but in reality, once the computer becomes the originator instead of facilitator, communication ceases to happen, and the product reverts back to irrelevant sounds.

There may come a time when computers achieve true artificial intelligence, at which point, much of this

argument will be moot. I am hesitant to stand in the way of progress, and historically some of the greatest inventions of *our* time were eviscerated by critics of *their* time for being the downfall of some great legacy. I believe, however, that the benefits of Emily Howell and other computer-composed technologies are currently exaggerated and little more than novelties, and as we explore this new frontier of computer-assisted composition, we should be wary of potential negative consequences.

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Notes

[Ed. Note: In addition to the comments and references cited below, Noah Stern Weber, the author of the present article, wanted to cite Andrew Aziz's article, "Algorithmic Style Analysis," a history and evolution of artificial intelligence as it relates to music analysis and composition, which focuses on Cope quite a bit. According to Weber, "The article is fairly technical, but is the best discussion of the actual compositional process that is shorter than a book. It may be too esoteric for a general audience, but I found it very helpful as I began my research for this article. I believe it would be of interest to those who want to learn more on the subject."—FJO]

1. "Unfortunately, I fear that she, like all of us involved with the making of new art, faces a hellish uphill battle, for all too often, performers, reviewers, and audiences rely on the proven rather than on the risky, and choose to repeat rather than initiate our creative experiences. What a shame that Emily's music, like the music of her human counterparts, will most likely find itself buried in complacency, never having the opportunity to be heard and appreciated in her time."—Excerpted from the Introductory Notes to the Emily Howell CD *From Darkness, Light*, Centaur 3023 (2010))

2. The Loebner Competition, an annual test of a computer's capacity to pass the Turing Test is limited to a five-minute discussion. The computer's best course of action was summarized by three time "Most Human Computer Award" Winner Richard Wallace as engaging in "stateless" conversation. "Experience with [Wallace's chatbot] ALICE indicates that most casual conversation is 'stateless,' that is, each reply depends only on the current query, without any knowledge of the history of the conversation required to formulate the reply." The programs that do best in the Loebner Competition tend to speak like a teenager through text-message, preprogrammed with stock responses, pop-culture references, and innocuous jokes. When it does not know how to respond, it abruptly changes the subject. (For a discussion on the Loebner Competition and AI, see: Brian Christian, "Mind vs. Machine," *The Atlantic*, March 2011.)

3. A standard unmatcheable message from eHarmony: eHarmony is based upon a complex matching system developed through extensive testing of married individuals. One of the requirements for it to work successfully is for participants to fall into our rigorously defined profiles. If we aren't able to match a user well using these profiles, the most considerate approach is to inform them early in the process... Our matching system is not suitable for about 20% of potential users, so 1 in 5 people simply would not benefit from our service.

4. This returns to the idea of suspended rationality. Howell's algorithms only allow for an averaging of the discrepancies between a work and her core knowledge. If ten Emily Howells were given the task of analyzing the same series of works and producing something with that composite, the output would be very similar. Humans will be drawn to different elements of the series and will produce markedly different works. Our learning is idiosyncratic; it is what differentiates personalities and dispositions. We valuate new ideas by combining our past knowledge with our personal aesthetics and tastes. A person can be fundamentally changed by a concept that challenges their preconceived notions of a subject—Emily Howell's algorithm can only weigh it against what it already knows.

[5.] Because of size constraints, I could not highlight the vast majority of these issues, but a copy of the score with each discrepancy can be downloaded at noahsweber.com/supplement.htm.

[6.] This cycle repeats every two measures: Nine of the twelve tones are used repeatedly, avoiding the last three. The missing tones are played simultaneously by the accented piano and the clarinet (later the flute), completing the aggregate, at which point the sequence begins again.

[7.] Excerpted from the introductory notes included in the score of *Land of Stone*.

[8.] "The attitude towards the indisputable facts of the status and condition of the composer of what we will, for the moment, designate as 'serious,' 'advanced,' contemporary music. This composer expends an enormous amount of time and energy—and, usually, considerable money—on the creation of a commodity which has little, no, or negative commodity value. He is, in essence, a "vanity" composer. The general public is largely unaware of and uninterested in his music. The majority of performers shun it and resent it. Consequently, the music is little performed, and then primarily at poorly attended concerts before an audience consisting in the main of fellow 'professionals'. At best, the music would appear to be for, of, and by specialists." ("Who Cares if You Listen?" *High Fidelity*, VIII/2 [February 1958] pp38-40, 126-7.)

[9.] Cope has written a program similar to Brutus.1 which composes poems.

[10.] Warren Riddle, " A Robo-Symphony: David Cope Composes 'Human' Music With A.I." *Switched*, February 27, 2010.

[11.] Surfdaddy Orca, "Has Emily Howell Passed the Turing Test?," *H+ Magazine*, March 22, 2010

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Noah Stern Weber

http://www.newmusicbox.org/article.nmbx?id=6983

Religious Experiences Shrink Part of the Brain

A study links life-changing religious experiences, like being born again, with atrophy in the hippocampus

By Andrew Newberg | May 31, 2011 | 59

Religion changes the brain. *Image: Roger Branch*

The article, "Religious factors and hippocampal atrophy in late life," by Amy Owen and colleagues at Duke University represents an important advance in our growing understanding of the relationship between the brain and religion. The study, published March 30 in *PLoS One*, showed greater atrophy in the hippocampus in individuals who identify with specific religious groups as well as those with no religious affiliation. It is a surprising result, given that many prior studies have shown religion to have potentially beneficial effects on brain function, anxiety, and depression.

A number of studies have evaluated the acute effects of religious practices, such as meditation and prayer, on the human brain. A smaller number of studies have evaluated the longer term effects of religion on the brain. Such studies, like the present one, have focused on differences in brain volume or brain function in those people heavily engaged in meditation or spiritual practices compared to those who are not. And an even fewer number of studies have explored the longitudinal effects of doing meditation or spiritual practices by evaluating subjects at two different time points.

In this study, Owen et al. used MRI to measure the volume of the hippocampus, a central structure of the limbic system that is involved in emotion as well as in memory formation. They evaluated the MRIs of 268 men and women aged 58 and over, who were originally recruited for the NeuroCognitive Outcomes of Depression in the Elderly study, but who also answered several questions regarding their religious beliefs and affiliation. The study by Owen et al. is unique in that it focuses specifically on religious individuals compared to non-religious individuals. This study also broke down these individuals into those who are born again or who have had life-changing religious experiences.

The results showed significantly greater hippocampal atrophy in individuals reporting a life-changing religious experience. In addition, they found significantly greater hippocampal atrophy among born-again

Protestants, Catholics, and those with no religious affiliation, compared with Protestants not identifying as born-again.

The authors offer the hypothesis that the greater hippocampal atrophy in selected religious groups might be related to stress. They argue that some individuals in the religious minority, or those who struggle with their beliefs, experience higher levels of stress. This causes a release of stress hormones that are known to depress the volume of the hippocampus over time. This might also explain the fact that both non-religious as well as some religious individuals have smaller hippocampal volumes.

This is an interesting hypothesis. Many studies have shown positive effects of religion and spirituality on mental health, but there are also plenty of examples of negative impacts. There is evidence that members of religious groups who are persecuted or in the minority might have markedly greater stress and anxiety as they try to navigate their own society. Other times, a person might perceive God to be punishing them and therefore have significant stress in the face of their religious struggle. Others experience religious struggle because of conflicting ideas with their religious tradition or their family. Even very positive, life-changing experiences might be difficult to incorporate into the individual's prevailing religious belief system and this can also lead to stress and anxiety. Perceived religious transgressions can cause emotional and psychological anguish. This "religious" and "spiritual pain" can be difficult to distinguish from pure physical pain. And all of these phenomena can have potentially negative effects on the brain.

Thus, Owen and her colleagues certainly pose a plausible hypothesis. They also cite some of the limitations of their findings, such as the small sample size. More importantly, the causal relationship between brain findings and religion is difficult to clearly establish. Is it possible, for example, that those people with smaller hippocampal volumes are more likely to have specific religious attributes, drawing the causal arrow in the other direction? Further, it might be that the factors leading up to the life-changing events are important and not just the experience itself. Since brain atrophy reflects everything that happens to a person up to that point, one cannot definitively conclude that the most intense experience was in fact the thing that resulted in brain atrophy. So there are many potential factors that could lead to the reported results. (It is also somewhat problematic that stress itself did not correlate with hippocampal volumes since this was one of the potential hypotheses proposed by the authors and thus, appears to undercut the conclusions.) One might ask whether it is possible that people who are more religious suffer greater inherent stress, but that their religion actually helps to protect them somewhat. Religion is frequently cited as an important coping mechanism for dealing with stress.

This new study is intriguing and important. It makes us think more about the complexity of the relationship between religion and the brain. This field of scholarship, referred to as neurotheology, can greatly advance our understanding of religion, spirituality, and the brain. Continued studies of both the acute and chronic effects of religion on the brain will be highly valuable. For now, we can be certain that religion affects the brain--we just are not certain how. Are you a scientist? And have you recently read a peer-reviewed paper that you would like to write about? Please send suggestions to Mind Matters editor Gareth Cook, a Pulitzer prize-winning journalist at the Boston Globe. He can be reached at garethideas AT gmail.com or Twitter @garethideas.

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http://www.scientificamerican.com/article.cfm?id=religious-experiences-shrink-part-of-brain

The Fog of Cyberwar: What Are the Rules of Engagement?

Countries are beginning to develop cyberwarfare policies to protect their national interests, but defending oneself in the borderless Internet will prove problematic

By Larry Greenemeier | June 13, 2011

CYBER OFFENSIVE: Politicians, pundits and security experts disagree as to whether the age of cyber warfare us upon us. That has not stopped countries, including the United States, from making preparations. *Image: COURTESY OF JOHN SOLIE VIA ISTOCKPHOTO.COM*

There is speculation among some politicians and pundits that the fog of war will soon extend to the Internet, if it has not done so already, given a recent report that the U.S. Department of Defense will introduce its first cyberwarfare doctrine this month, combined with similar announcements from the governments of Australia, China and the U.K. (not to mention Google's ongoing cyber spat with China). Less clear, however, are the rules of engagement—such as what constitutes an act of cyberwar as opposed to the cyberattacks that take place on government computers every day and who, if anyone, should mediate such disputes.

Wars have traditionally been waged between nations or clearly defined groups that officially declare themselves in conflict. This has yet to happen openly on the Internet, although such accusations have been leveled against China, Russia and other nations, says Chris Bronk, an information technology policy research fellow at Rice University's James A. Baker III Institute for Public Policy in Houston and a former U.S. State Department diplomat.

Cyberwarfare is more likely to reflect the wars fought against shadowy terrorist networks such as al-Qaeda as

opposed to conflicts between uniformed national military forces. "One thing about war is that, historically, the lines have been drawn and there is an understanding of who the enemy is," says David M. Nicol, director of the Information Trust Institute at the University of Illinois at Urbana-Champaign. "When a cyberattack occurs against a sovereign state, who do you declare war on?"

The Defense Department is expected to clarify at least some of these gray areas when it releases its cyberwarfare doctrine, the *Wall Street Journal* reported last month. This would not be the Pentagon's first foray into managing cyberwar. The U.S. Strategic Command's U.S. Cyber Command (USCYBERCOM) division has been operational since October and is designed to centralize the administration of cyberspace operations, organize existing cyber resources and synchronize defense of U.S. military networks. What is missing is a clear set of publicly declared rules under which USCYBERCOM will operate, Bronk says, adding, "We can't say there is a cyber command and then not have rules of the road like you do for other areas of military conduct."

Other countries seem to be following suit. The U.K. is developing a cyberweapons program that will give ministers an attacking capability to help counter growing threats to national security from cyberspace, the *Guardian* reported last month. Australia is also on record as saying it will create the country's first national cybersecurity strategy to confront the growing threat posed by electronic espionage, theft and state-sponsored cyberattack, the *Sydney Morning Herald* recently reported. Not to be left out, China has also set up a specialized online "Blue Army" unit that it claims will protect the People's Liberation Army from outside attacks, according to News Track India.

The inability of governments, or any other cybersecurity experts for that matter, to pinpoint the origin of cyberattacks is problematic and boils down to an intelligence problem, Nicol says. "Right now, with the infrastructure that we have it's very difficult using purely technological means to trace the source of some kind of attack," he adds. "You can't just look at the connection between one computer and another because cyberattackers use multiple levels of cutout servers that make it difficult to determine where data is being sent. These computers that do the cutoffs are in foreign countries so there's little recourse in terms of requesting log files from those computers."

This lack of clarity is troubling. "We're nowhere near where our policy makers believe we are or want us to think we are," says Anup Ghosh, a research professor and chief scientist at George Mason University's Center for Secure Information Systems in Fairfax, Va. "Internet Protocol (IP) was never designed with strong attribution properties. There's no connection between an IP address and an individual."

In cyberspace, it is easy to masquerade as someone else. "As naked as we are in security, so is China," says Ghosh, also co-founder and CEO of cybersecurity technology maker Invincea. "Their security might even be worse than ours, which is pretty sad. It wouldn't be hard to use China as a jumping-off point if you're in organized crime or another nation state looking to cause some saber rattling between China and the U.S."

Much of the U.S.'s current tension with China comes from Google's claims that recent hacker attempts to steal Gmail user passwords appeared to have originated from China. "Google is a very secure company, so when they are attacked we should stand up and take notice," says O. Sami Saydjari, a former Pentagon cyber expert who now runs a consultancy called Cyber Defense Agency. At the national level, however, "clearly you want to be able to attribute an attack with a degree of certainty before you respond with military action," he adds.

Internet agencies such as the Internet Corporation for Assigned Names and Numbers (ICANN) might be a reasonable place to start when trying to improve cybersecurity and avoid international cyberconflicts, but essentially this is a problem requiring input from the U.S. State Department and international policy makers and perhaps even something along the lines of an Internet Geneva Convention, Saydjari says. "One option is to make countries [that are] unwilling to trace the source of cyberattacks coming from within their borders

accountable for the results of those attacks," he adds. "We also need more think tanks in this space such [as] we had during the cold war, where analysts discussed the consequences of nuclear weapons and mutually assured destruction."

If the U.S. chooses to enter a new war with another country within the next decade, there will be cyberweapons deployed under the guidance of cyberdoctrine to scramble communications and otherwise disrupt the enemy, Bronk says. "I would assume that the cyberattacks that we would consider as acts of warfare would be clandestine in nature, with Stuxnet being an example of how this might happen," he adds, referring to the highly sophisticated Microsoft Windows computer worm that made headlines last year when it attacked targets in Iran, leading to speculation that it was developed by the U.S. or Israel.

The threat of cyberwar "is like any great security problem; the key is not to either overreact or underreact but [to] have a calibrated response based on the knowledge we hold," Bronk says. "The problem is our knowledge is very, very limited. This is the infancy of this issue."

http://www.scientificamerican.com/article.cfm?id=fog-of-cyber-warfare

Rings and Worms Tell the Tale of a Shipwreck Found at Ground Zero [Slide Show]

Researchers were stunned to find an 18th-century ship that had been unearthed by construction workers at the World Trade Center where the Twin Towers once stood. With great care they followed clues in the well-preserved wood to trace the craft's history to the era of the American Revolution

By Lynne Peeples | June 10, 2011 | 5

Image:

Twenty-three duct-taped packages chilled in a refrigerator at Columbia University's Lamont–Doherty Earth Observatory in Palisades, N.Y., for months before scientists finally got up the nerve last December to pull them out and peel them open.

Neil Pederson's team had initially chickened out. His tree-ring experts knew that the 200-year-old fragments inside were of interest to more than just their fellow dendrochronologists.

That's because the packages were the precious raw data derived from an unusual discovery last July made by workers at the World Trade Center construction site in New York City. Three stories below street level, buried among rotten piers and other landfill once used to extend Manhattan's shoreline, emerged a well-preserved skeleton of an old wooden ship.

The aged wooden planks were in a very delicate state, making any investigation into their age and origin especially daunting.

In the days that followed the find archaeologists overseeing the excavation at the massive construction site carefully documented and pulled from the pungent mud about nine meters of what remained of the USS *Adrian*—named after the construction site supervisor. The original vessel is estimated to have been at least twice that long.

But the rest of the ship's story remained buried. Where was it built, and when? Where did it sail, and why?

"This shipwreck gives us a glimpse of the past—the last chapter in a complex story. We can start rebuilding and rewriting those other chapters of a ship's life by doing things like dendrochronology," says tree-ring specialist Pearce Paul Creasman of the University of Arizona, in Tucson.

"The boat had a lifetime before it got to that point," adds Creasman, who was not involved in the project.

Over the next several months, a range of experts would start nailing down some important clues. Most recent are the newly released conclusions from the Columbia team's tree-ring analysis. In their report Pederson and his colleagues suggest that the ship was likely built in 1773 in a small shipyard on the outskirts of a major metropolitan center.

A maritime historian and a plant pathologist, among others, analyzed data ranging from horseshoe crabs to shipworms to help corroborate these findings and fill in other blanks.

"Various aspects of scientific research have contributed pieces to the puzzle," says Molly McDonald, an archaeologist with the firm AKRF, Inc., the environmental and planning consultants monitoring the World Trade Center site for the Port Authority of New York & New Jersey. "All of them help us to understand a moment in history."

http://www.scientificamerican.com/article.cfm?id=rings-worms-tale-ground-zero-shipwreck

Tevatron teams clash over new physics

Independent search fails to confirm earlier report of novel particles.
Eugenie Samuel Reich

The Tevatron particle accelerator's two experiments disagree about whether they have seen a new kind of particle.Fred Ullrich/ Fermilab

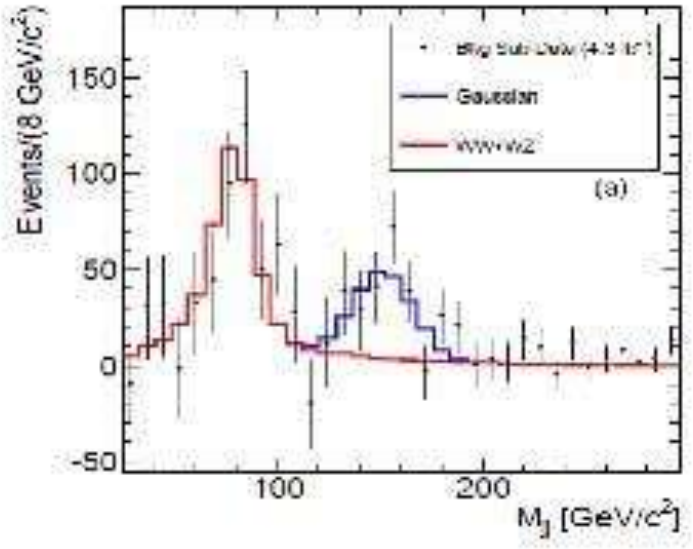
Research groups at the Tevatron, the proton-antiproton collider at Fermilab in Batavia, Illinois, have reached starkly different conclusions about a possible sighting of new particles beyond what is expected under the standard model of particle physics.

In April, researchers on the Collider Detector at Fermilab (CDF) experiment reported tentative evidence that particles not predicted by the standard model had surfaced in collisions that produced a W boson — a particle of the weak nuclear force — and jets of other particles[1]. In May, they released data strengthening the case for the novel particles[2], and theorists have submitted at least a dozen articles to the online preprint server arXiv trying to explain them.

But today, researchers on the independent D0 experiment, also at Fermilab, announced that their data do not confirm the signal. "The result is not good for the CDF. We are not confirming the signal. We just see nothing," says Dmitri Denisov, spokesman for D0, which released its results online today[3].

Comparisons needed

Disagreement between the CDF and D0 is rare. Denisov estimates that of the roughly 500 papers produced by the two experiments over the past decade, there have been only two or three significant disagreements. As spokesman for D0, he's naturally more confident in its result, and he suspects that something may be wrong with the way the CDF modelled background events from which its signal was extracted.



A spectrum showing events producing a W boson and jets were produced showed an unexpected bump (in blue) around 145 GeV, pointing to the possible production of new particles. Click for larger image.CDF Collaboration, Fermilab

But Rob Roser, a spokesman for the CDF, says the collaboration used state-of-the-art techniques for their analysis and held a careful review, as he believes D0 also did. The next step will be for the two teams to sit down together to compare each other's analyses, plot by plot, he says. "This is a hard problem and it will take a while to tease out," he adds.

Although the Tevatron is due to shut down in September, data analysis will continue, and Denisov says that there should already be enough data to resolve the conflict by comparing the analyses.

The anomaly seen by the CDF was an excess in the number of events in which proton-antiproton collisions produced a W boson and two jets of other particles. The excess, evident as an unexpected bump in the energy spectrum of the jets (blue bump in graph), pointed to the production of new particles, not predicted by the standard model, that decayed to produce the extra jets. The statistical significance of the excess is about 4.1 sigma, only just short of the 5 sigma needed to claim a discovery. D0's spectrum in the same energy range shows no bump, Denisov says, which corresponds to a 4.3 sigma negative result.

Teams on the Large Hadron Collider at CERN, Europe's particle-physics lab near Geneva, Switzerland, have also been checking their data, and have so far failed to see anything to support the CDF's sighting. But Guido Tonelli, the spokesman for CERN's Compact Muon Solenoid (CMS) experiment, cautions that the amount of data collected by the LHC is still too small for a definitive statement to be made. "We want to be sure we will have significance," he says. He expects the CMS to have enough data to test the CDF sighting by the end of June, and it will report its results at the European Physical Society's conference on high-energy physics in Grenoble, France, at the end of July.

Theoretical speculation

In the meantime, the conflict between the CDF and D0 is likely to create headaches for theorists, says Pran Nath, a theoretical particle physicist at Northeastern University in Boston, Massachusetts, who has proposed an extension of the standard model to explain the CDF result. "If experiments are ambiguous we cannot rely on them," he says. Nath adds that, if the CDF result does turn out to be wrong, he will be disappointed. "You might say wild goose chase is the right way to put it."

Scott Thomas, a theoretical particle physicist at Rutgers University in Piscataway, New Jersey, says that he will be looking closely at the D0 result. He has already looked at the CDF's analysis and thought the team did a careful job. "It's a very difficult measurement, but it seemed like they did everything they could," he says.

He adds that even if the CDF result turns out to be wrong, the theoretical work done to try to explain it has highlighted several new ways that physics beyond the standard model can be tested in collider data, which might come in useful at the LHC. "It's still been worthwhile," he says.
For his part, Denisov thinks that it is time to put theoretical speculations on hold and to let the experiments work out their differences. "It's unreasonable to talk about new physics now," he says. "It's back to the drawing board."

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Whose Money Is It, Anyway?

June 8, 2011

To the average faculty member, the life of an endowed chair or director of an endowed program must seem wonderful. Shielded from the somewhat turbulent world of university finances, those professors seem to have a constant stream of revenue for their own intellectual pursuits.

But Dartmouth College is siphoning more funds out of those streams to irrigate thirsty areas in the rest of the university.

To help patch a $100 million budget gap, administrators increased the percentage they take from some endowment returns to help pay for administrative costs, a move that has angered some faculty members who have raised questions about the ethics of the move and the lack of information provided to faculty members.

Because of the policy shift, about $2 million that would have previously gone to endowment recipients will now go to the administrative unit that oversees each recipient. The College of Arts and Sciences will receive an additional $250,000, for example, based on the endowment returns of its endowed chairs and programs.

The change is part of a comprehensive plan that included budget cuts in areas such as administrative and programming support, benefits, and compensation. Faculty members have been vocal in demanding more information from administrators about how the cuts were made, and especially regarding the endowment levy; they say they weren't clearly notified of the change.

"People are troubled by the ethical questions that it raises," said Ronald M. Green, a professor in the religion department with an endowed chair and one of the prominent critics. "Can central administration take money that was directed for a specific program or departmental purpose?" Many donors who thought that about 85 percent of their gift money was going straight to whatever areas they supported now have no choice but to see more of the funds shifted to administrative costs.

The discussion at Dartmouth draws attention to a part of fund-raising and endowment management that is often overlooked, particularly at universities that are very dependent on endowment revenue: who pays for everything that's not as exciting as a new faculty chair or fellowship program. Such programs can actually be a drain on universities if they don't have the resources to maintain associated costs.

Since 1999, the university has redirected 14.29 percent of the payouts for endowed programs that don't explicitly bar such action to the administrative unit to cover what it calls "associated program costs." These costs can include things like electricity, facilities, and IT. Administrators liken the levy to the component of federal grants directed for overhead costs, which range in percentage but can often be as high as 50 percent of a grant. They argue that the percentage that is taken from the endowment returns for administrative costs still goes toward the goals of the gift, just in a different form, and that the money still doesn't cover the associated costs and must be supplemented by other revenue sources.

In determining how to patch the budget gap, administrators decided to raise that rate to 19.1 percent, effective July 1.

Two factors caused the almost $100-million budget hole at Dartmouth. The first was a drop in endowment returns -- a large component of Dartmouth's revenue -- caused by the stock market decline. The second was that the university had increased its endowment payouts in the period leading up to the recession and had to lower that payout rate once the market dipped.

So faculty members who already saw endowment returns drop because of the stock market or because of the decision to decrease payouts will now see more taken out of the returns for associated costs.

The decision to up the percentage directed toward administrative costs was made after examining how best to cover costs associated with endowments and exploring how peer institutions cover such costs, said Carrie Pelzel, senior vice president for advancement at Dartmouth. Notes to administrators' May 23 presentation about the budget to the Arts and Sciences faculty say that tactics used by other universities "include charging fees ranging from 8 percent to 12 percent on gifts as they are received, which Dartmouth does not do; levying an administrative charge at endowment distribution, ranging from 20 percent to 25 percent, which is comparable to Dartmouth's associated program cost rate; and charging other administrative fees, including development, which Dartmouth does not do."

"There are schools whose rate is higher, and some whose rate is lower," Pelzel said, but she would not say which universities fell into those categories.

Green said he would be more comfortable with the change if he knew that it put Dartmouth in line with other universities in the Ivy League, including the rate as well as how donors are notified. The university notifies donors when they make a gift that some of the money goes to associated program costs. Administrators are working on a plan to tell donors about the change.

Practices at other institutions vary. A spokeswoman for Cornell University said the university had no fees attached to its gifts and does not earmark any for administrative costs. A spokesman for Columbia University said "the university directs a percentage of gifts to help its schools recover a portion to support their administrative and central costs. While the rates vary somewhat, they generally do not exceed 10 percent." For non-endowed gifts, these fees are charged as the money is paid out. For endowed donations, the fees are charged as the income generated from the endowment is used. Harvard officials declined to comment on the university's policies.

The practice of directing gifts or endowment returns to pay for costs not directly proscribed by the donor is common, and most colleges and universities explain and spell out that component of the gift, said Rae Goldsmith of the Council for Advancement and Support of Education. Sometimes this money goes to supporting fund-raising efforts, and other times it goes toward administrative or overhead costs.

But because colleges and universities have widely differing practices on using fund-raising money for overhead or other administrative costs; because private colleges and universities are not obligated to report to the public what their policies are; and because public university fund-raising is often conducted by private foundations, it is hard to place where Dartmouth's change puts it on the spectrum.

CASE says it is common practice for colleges and universities, particularly public university foundations, to use a portion of initial gifts to pay for fund-raising options. The rate tends to be around 5 percent. At the University of California at Berkeley, the university takes 2.5 percent of donor gifts and 10.5 percent of research gifts, unrestricted funds used to support the research of one or more faculty members.

"The college at that time wanted to choose an approach would direct as much of revenue as possible to the actual activity being supported by donor," Pelzel said. "In their judgment, this policy would achieve this end." The California Institute of Technology directs 15 percent of endowment payouts to overhead costs, as well as taking 15 percent of unrestricted gifts.

At the May 23 meeting at Dartmouth, faculty members passed a resolution calling for more transparency about how the budget gap was closed, particularly with regard to the endowment levy. Administrators said they would comply with that request.

— Kevin Kiley

http://www.insidehighered.com/news/2011/06/08/dartmouth_takes_more_money_from_endowment_returns_for_administrative_costs

Species spellchecker fixes plant glitches

Online tool should weed out misspellings and duplications.
John Whitfield

Would it smell as sweet by any other name?R. Evans/Photolibrary

Brian Enquist and his collaborators were delighted with their freshly compiled data set of 22.5 million records on the distribution and traits of plants in the Americas. But their delight turned to horror when they realized that the data set contained 611,728 names: getting on for twice as many as there are thought to be plant species on Earth.

Completed in December 2010, the records were intended to help Enquist and his colleagues to discern trends in how forest trees in a wide variety of environments respond to climate change. But the data were clearly full of bogus names, making it impossible to count the species in a particular area, or their relative abundance. "I started to question our ability even to compare something as basic as species diversity at two sites," says Enquist, a plant ecologist at the University of Arizona in Tucson.

This month, Enquist's team will unveil a solution that could help botanists and ecologists worldwide. The Taxonomic Names Resolution Service (TNRS) aims to find and fix the incorrect plant names that plague scientists' records.

"It looks really good," says Gabriela Lopez-Gonzalez, a plant ecologist at the University of Leeds, UK, who curates a database of forest plots. Fixing species lists by hand is arduous, she says. "This should save us a lot of time".

She and others agree that the problem is widespread in botanical databases. "Digitization has made the problem worse," says TNRS co-leader, botanist Brad Boyle, also at the University of Arizona. Boyle explains that as more data are added to digital records, the chance of introducing errors also increases. Even in herbarium specimens, which ought to be the gold standard for plant identification, about 15% of the names are misspelt, he says.

Many of the errors seem to arise because biologists are not as careful as they should be when entering data into digital records. The TNRS team estimates that about one-third of the names entered into online repositories — such as GenBank, the US National Institutes of Health collection of DNA-sequence data, or the Ecological Society of America's VegBank database of plant-plot data — are incorrect.

The other problem is that names change. Old names can be abolished when experts reclassify plants as ideas about evolutionary relationships change, or when they realize the species already had a name — an occurrence almost as old as taxonomy itself. The result is that the same plant can have many names, and not everyone knows which one to use. Such synonyms are a particular problem in the study of medicinal plants, says Alan Paton, a plant taxonomist and bioinformatician at Kew Gardens in London.

The TNRS was built with financial and technical support from iPlant, a project run by the US National Science Foundation to fund cyberinfrastructure for plant science. It corrects names by comparing lists that users feed into it with the 1.2 million names in the Missouri Botanical Garden's Tropicos database, one of the most authoritative botanical databases. If the TNRS cannot find a name in Tropicos, it uses a fuzzy-matching algorithm, similar to a word-processor's spellchecker, to find and correct misspellings. It also hunts through Tropicos's lists of alternative names and supplies the one that is most up to date. When Enquist ran the 611,728 names through the system, just 202,252 came back, showing that two-thirds of them were invalid. Because Tropicos is less comprehensive for plants outside the Americas, the team hopes to link the TNRS with The Plant List (www.theplantlist.org), a collaborative compilation of databases from Kew and other sources. Launched online in December 2010, it aims to become a global record of plants. The scientists are also working on a tool to correct geographical data — one that knows, for example, that Brazil, Brasil and Brésil are the same place, and can recognize when someone has muddled up longitude and latitude.

http://www.nature.com/news/2011/110613/full/474263a.html

Researchers call for nuclear data release

Trove of data from Fukushima and beyond could improve nuclear monitoring and benefit research.
Geoff Brumfiel

A global network of sensors fed into this model of radiation from Fukushima.ZAMG

Shortly after a massive tsunami struck the Fukushima Daiichi nuclear power plant on 11 March, an unmanned monitoring station on the outskirts of Takasaki, Japan, logged a rise in radiation levels. Within 72 hours, scientists had analysed samples taken from the air and transmitted their analysis to Vienna, Austria — the headquarters of the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), an international body set up to monitor nuclear weapons tests.

It was just the start of a flood of data collected about the accident by the CTBTO's global network of 80 radiation monitoring stations. In the following weeks, the data were shared with governments around the world, but not with academics or the public. Now scientists working with the CTBTO on behalf of member states are calling for the data to be released, both to give other researchers an opportunity to use them, and to improve the network's performance.

"What I'm after is to make this dataset available to the scientific community," says Wolfgang Weiss, head of the department of radiation protection and health at Germany's Federal Office for Radiation Protection in Munich. In the coming weeks and months he hopes to persuade member nations overseeing the CTBTO to approve new rules for sharing data with other international bodies and scientific researchers.

The CTBTO was set up in 1996 with the eventual goal of enforcing an international ban on all nuclear testing. The treaty is not yet finalized, but the organization has already set up a global network to verify nuclear tests, measuring seismic, hydro-acoustic and infrasound data as well as radiation. In 2006 and 2009, it confirmed two tests by North Korea, using data from a combination of seismic and radioisotope tracking stations.

Those monitoring stations pick up other things as well. In the latest crisis, the network's sensitive radiation detection sensors were overwhelmed by radioisotopes streaming out of the damaged reactors at Fukushima Daiichi. Monitoring posts picked up isotopes such as iodine-131 and caesium-137 that were of concern to public health officials in other countries. Other radioisotopes such as niobium-95 and rubidium-103 were an early indicator of a meltdown inside one or more of the reactors.

Under wraps

In keeping with its remit, the CTBTO shared data with designated scientific institutions in its member states, but not with other scientists or the public. Some members, such as Austria, subsequently released analyses based on the data, whereas others kept it private (see 'Radiation data from Japanese disaster starts to filter out').

At a meeting held in Vienna from 8-10 June, scientists working with the CTBTO took a moment to reflect on the network's performance. Detection stations tracked the radiation from the accident, and atmospheric models worked well; yet questions remained. Why did the radiation spread so quickly to the Southern Hemisphere? Were ratios of xenon isotopes unusual because reactor physics are poorly understood, or because of equipment being miscalibrated? Answering such questions will help the network to trace future weapons tests. "There are things that are not understood fully, and [the data] should be made available to science," Weiss told scientists during a 9 June panel.

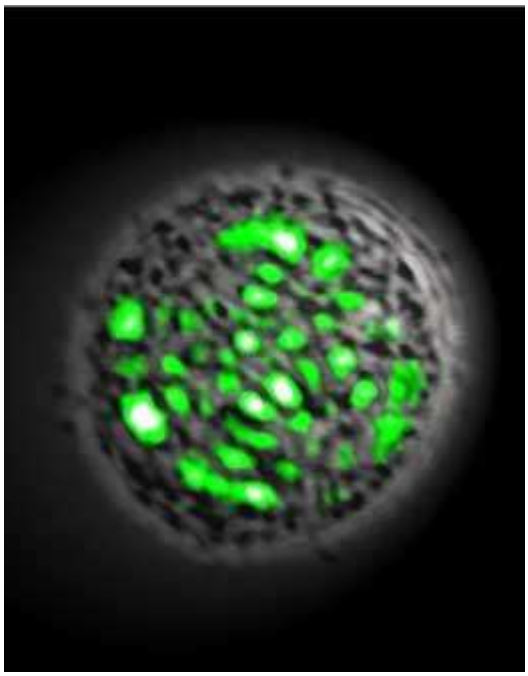
The network itself could also be interesting scientifically, says Gavin Schmidt, a climate modeller at NASA's Goddard Institute for Space Studies in New York. Climate researchers use some short-lived radioisotopes of elements such as beryllium to study mixing between atmospheric layers. And the radioactive debris from Fukushima could help meteorologists to develop their models of how air circulates nearer the Earth's surface. "It's clear that there's a potential to be useful," Schmidt says. "There's often interesting science there that wasn't the focus of the people who designed the network."

Wider sharing of data from the CTBTO network is not unprecedented. After the 2004 Indian Ocean tsunami that killed hundreds of thousands of people, member states decided to incorporate the network's seismic data into tsunami-warning systems throughout the region. The Fukushima crisis may trigger a similar move to open radioisotope data further, says Lassina Zerbo, director of the CTBTO's International Data Centre. But ultimately it will be up to the nations that pay for the network. "We do what the member states tell us we should do," he says.

http://www.nature.com/news/2011/110613/full/news.2011.366.html

Human cell becomes living laser

Jellyfish protein amplifies light in first biological laser.
Zoë Corbyn



Microscope image of a living laser in action. Due to the irregular internal structure of the cell, the laser spot has an apparently random pattern.Malte Gather

Scientists have for the first time created laser light using living biological material: a single human cell and some jellyfish protein.

"Lasers started from physics and are viewed as engineering devices," says Seok-Hyun Yun, an optical physicist at Harvard Medical School and Massachusetts General Hospital in Boston, who created the 'living laser' with his colleague Malte Gather. "This is the first time that we have used biological materials to build a laser and generate light from something that is living." The finding is reported today in Nature Photonics [1].

Building a laser requires two things: a lasing material that amplifies light from an external source (a 'gain medium') and an arrangement of mirrors (an 'optical cavity'), which concentrates and aligns the light waves into a tight beam. Until now, the gain medium has only been made from non-biological substances such as doped crystals, semiconductors or gases, but in this case the researchers used enhanced green fluorescent protein (GFP) — the substance that makes jellyfish bioluminescent, which is used extensively in cell biology to label cells.

The team engineered human embryonic kidney cells to produce GFP, then placed a single cell between two mirrors to make an optical cavity just 20 micrometres across. When they fed the cell pulses of blue light, it emitted a directional laser beam visible with the naked eye — and the cell wasn't harmed.

The width of the laser beam is "tiny" and "fairly weak" in its brightness compared to traditional lasers, says Yun, but "an order of magnitude" brighter than natural jellyfish fluorescence, with a "beautiful green" colour.

Illuminating biology

Yun and Gather have some broad and speculative ideas about how the technology might be used.

They suggest that biologists could turn cells of interest into lasers to study them. The light produced has a unique emission spectrum related to both the structure of the cell and the proteins inside it. "By analysing the pattern you can get some idea of what is happening inside the cell," says Yun.

The researchers also suggest possible medical applications. Doctors today shine lasers into the body to gather images or to treat disease by attacking cells. Yun thinks that lasers could instead be generated or amplified inside the body, where they could penetrate the relevant tissues more deeply.

But more work is needed first — including developing the laser so that it works inside an actual living organism. To achieve this, Yun envisages integrating a nano-scale optical cavity into the laser cell itself. Technologies to make such cavities are emerging, he says, and once they are available they could be used to create a cell that could "self lase" from inside tissue.

Experts praise the work as interesting and creative. "It is kind of neat," says Michael Berns, a biomedical engineer at the University of California, Irvine. "I have been working on cells and lasers for 40 years, and I don't think I would have thought of this."

But he says that the technique might more feasibly be used to study individual cells than for medical applications. He points out that external light is needed to stimulate the laser action, which would be difficult in the body, potentially limiting the technique to thin-tissue systems or cells in culture or suspension.

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http://www.nature.com/news/2011/110612/full/news.2011.365.html

UK climate projects evaporate

British Council axes climate-change work to balance books.
Daniel Cressey

The British Council is ending its climate change programmes, which have been praised by the UK's foreign office.Paul Miles/ Getty Images

An acclaimed series of climate-change projects are being discontinued by Britain's international-relations body, despite concerns from the government department that funds the work.

The British Council has decided not to continue funding several of its climate-change projects beyond this financial year. Although the council insists that it "has no intention of terminating our work around climate change", staff are starting to leave the programme and much of the work will be stopped.

The programme previously cost around £3 million (US$5 million) a year and has involved some 100 million people from around the world in projects that build links between scientists, artists, policy-makers and members of the public.

David Viner, who heads the council's climate programme, says that funding will not be continued for most work past the end of this month, and that all current climate-change programmes will be ended by March 2012. Nearly all staff specifically working on climate-change projects are either set to leave or have left, he says.

"The programme was based on a robust, evidence-based strategy," says Viner. "The work was very well received and welcomed by a plethora of external stakeholders. It put the United Kingdom right at the heart of the debate and gave it credibility," he says.

"The council has removed a programme described by the [Foreign and Commonwealth Office] as systematic and a national asset," Viner says.

The council says that it will continue some climate work, but it would be changing "direction and approach" in the areas of sport, science and climate change.

"After the government spending review last year, which reduced our grant funding by 26%, the council has refreshed its strategy to focus on the three core business areas of arts, english, and education and society," says Anne Wozencraft, the council's acting director of education and society.

"The sport, science and climate-change sectors will provide areas of content that can be incorporated within [our new core business areas], rather than lead our activity," she adds.

Few survivors

The council says that two flagship global projects will continue: the 'Climate Generation' initiative, which engages young climate activists and the 'Climate4Classrooms' project, which provides resources for schoolchildren. Two other programmes, for training the media and working with faith leaders, will also be ending, and a programme for building links between the arts sector and climate-change experts will be folded into other council programmes.

Nearly all of the council's funding is provided by the Foreign and Commonwealth Office (FCO). And in a letter dated 23 May, FCO minister Jeremy Browne urged the council to fund its climate-change work through to 2015 and expressed concerns that the council was preparing to "terminate rather than refresh" its systematic work on the issue.

The council would not comment on Browne's correspondence. A spokesman for the foreign office says that the council's corporate plan "has been agreed in consultation with the FCO. As with all organizations that receive public funding, it has had to reprioritize its work to accommodate reducing resources. We look forward to continuing working with the council on climate-change matters."

Well received

Bob Ward, policy and communications director of the Grantham Research Institute on Climate Change and the Environment at the London School of Economics, says that the council's work has been recognized as among the leading climate outreach programmes. "It would be a real mistake if it didn't continue with some kind of outreach on climate change. It was reaching a large number of people."

Asher Minns, centre manager for the Tyndall Centre for Climate Change Research at the University of East Anglia, UK, thinks that the council's work has been very good overall. "What it is doing on the international stage is, to the best of my knowledge, unrivalled," he says.

http://www.nature.com/news/2011/110610/full/news.2011.364.html

Summit plots route to clean electricity

Interdisciplinary talks call for investment in nuclear and geothermal power.
Jeff Tollefson

Finding ways of advancing low-carbon electricity, such as wind power, over the next two decades was the focus of the Equinox Summit.Michael Betts/ Getty Images

Harnessing the potential of geothermal energy and advanced nuclear reactors that burn nuclear waste could be part of a broader plan to create a low-carbon electricity system by 2030, a global group of scientists, policy experts and young environmental leaders concluded this week.

Released on 9 June, the communique from the Equinox Summit, held in Waterloo, Canada, endorses geothermal energy, renewables and advanced nuclear power while calling for batteries and grid technologies to help decarbonize urban electricity use. The document also emphasizes the role of new flexible and lightweight organic solar cells in bringing 'first light' to roughly 2.5 billion people currently without access to mains electricity.

"We focused on what science and technology can do to help reboot this conversation around how to decarbonize the global energy system," says the summit's science adviser, Jatin Nathwani, executive director of the Institute for Sustainable Energy at the University of Waterloo.

Sponsored by the Waterloo Global Science Initiative, a partnership between the University of Waterloo and the Waterloo-based Perimeter Institute for Theoretical Physics, the summit was designed to bring together scientists and young people working on the issue with advisers who could map out the policy terrain. After the initial science and technology presentations, the 36 participants split up into groups for meetings to assess the various technologies and develop a list of priorities.

Bright sparks

Jason Blackstock, an energy and climate expert at the Centre for International Governance and Innovation in Waterloo who helped organize the summit, says the technology road map produced at the summit presents some "exemplar pathways" but is not intended to be all-inclusive: "This is about demonstrating how science and policy can blend to generate and spark ideas." Blackstock says the goal is to use the networks formed at the conference to push these ideas in the coming months.

Jay Apt, a summit participant and executive director of Carnegie Mellon University's Electricity Industry Center in Pittsburgh, says it was interesting to watch people of different backgrounds interacting. "The biggest output might be a cadre of people who know how to think about these issues," he says.

"It was a very good exercise in trying to convene scientists and non-specialists," says Yacine Kadi, a physicist at CERN, Europe's particle physics lab in Geneva, Switzerland. "The feedback was tremendous."
Kadi pitched accelerator-driven nuclear reactors that run on thorium – a plentiful element present in sand – and nuclear waste, an old idea that has struggled to gain traction. As well as providing an alternative to uranium and plutonium and thus reducing proliferation concerns, he says, these reactors would shut down when the particle accelerator turns off, addressing safety questions that have arisen following the Fukushima disaster in Japan.

Dig for electricity

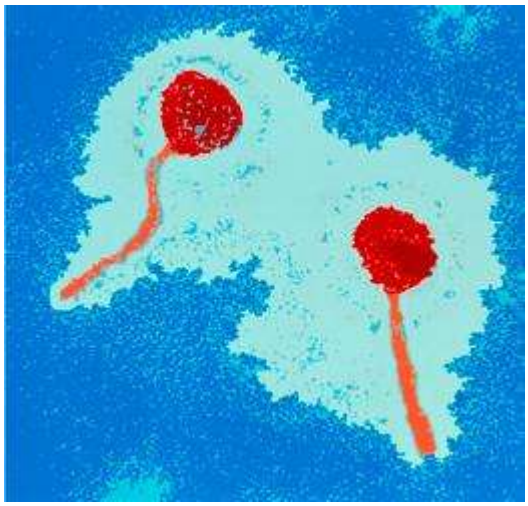
The Equinox communique called for a multinational initiative to advance thorium reactor research and development as well as the commercial demonstration of an 'integral fast reactor' that runs on reprocessed nuclear waste. "The allure of these technologies is simply too great to ignore," says Jakob Nygard, a summit participant from Denmark who is pursuing a master's degree in political science.

The communique endorsed traditional renewable energy coupled with batteries and called for $1 billion to be spent on 10-20 demonstration projects in geothermal energy. Tapping the heat of rocks several kilometres below ground could provide 10% of the world's baseline power requirements by 2030. Other initiatives targeted grid and communications technologies that could be used to make urban electric systems more efficient.
The recommendations were presented to officials and scientists representing the Canadian government and civil society.
But some said the conference might have focused too much on individual hi-tech solutions. "A lot of scientists have this superhero dream and say 'My technology is going to solve the world's problems,' but it's not that simple," says Ding Jianhua, an engineer who works on green development issues for the Center of Ministry of Housing and Urban-Rural Development in Beijing. She is already pushing for a follow-up conference next year that will focus on her own core interests of energy efficiency and conservation. "The superhero is the public, working together," Ding says

http://www.nature.com/news/2011/110610/full/news.2011.362.html

Phage on the rampage

Antibiotic use may have driven the development of Europe's deadly E. coli.
Marian Turner



Escherichia coli bacteria become dangerous to humans when they are infected by Shiga-toxin-producing bacteriophages.DR GOPAL MURTI/SCIENCE PHOTO LIBRARY

Women, beansprouts, cucumbers, bacteria, cows: the cast of the current European Escherichia coli outbreak is already a crowd. Enter the phage. Bacteriophages are viruses that infect bacteria, and they are star players in the chain of events that led to this outbreak.

Bacterial infections often originate from contaminated food, but it is now about six weeks since the start of this outbreak and the trail is going cold. It's hard to be sure of the culprit — but this simply serves to highlight the importance of understanding how infectious bacteria get into the food chain in the first place.

Case-control studies of patients in the German outbreak pointed to salad vegetables, and both cucumbers and beansprouts have been suspects. It is possible that the vegetables were contaminated with bacteria originally carried in soil or water; but the more likely source of the bacteria is animals. Pathogenic E. coli are typically passed to humans from ruminant animals (cows or sheep) via faecal contamination in the food chain or through consumption of raw milk or meat products.

But how do pathogenic E. coli arise in the first place? This is where bacteriophage come in. The bacterium in this outbreak, currently recognised as strain O104:H4, makes Shiga toxin, which is responsible for the severe diarrhoea and kidney damage in patients whose E. coli infections develop into haemolytic uremic syndrome (HUS). The genes for the Shiga toxin are not actually bacterial genes, but phage genes being expressed by infected bacteria. So when an E. coli bacterium gets infected with a Shiga-toxin-producing phage, it becomes pathogenic to humans.

Our use of antibiotics may be helping those viral genes to spread. If bacteria are exposed to some types of antibiotics they undergo what is called the SOS response, which induces the phage to start replicating. Active replication of the phage causes the bacterial cells to burst open, which releases the phage. It also releases the toxin, which is why antibiotics are not usually used to treat E. coli infections (see 'Europe's E. coli outbreak: time for the antibiotics?').

The cost of protection

One of the many unusual characteristics of strain O104:H4 is that it has resistance genes to multiple classes of antibiotics. This suggests that wherever the bacteria have come from, there has been selective pressure to resist antibiotics. Heather Allison, a microbiologist at the University of Liverpool, UK, and David Acheson, a managing director for food safety at consulting firm Leavitt Partners in Washington DC, agree it is plausible that exposure to antibiotics — in agricultural use or in the environment — might be enhancing the spread of Shiga-toxin-producing phage.

“We are seeing more and more Shiga-toxin-producing strains.”
Alison Weiss

Acheson worked on this question when he led a research group at Tufts University in Medford, Massachusetts, studying the molecular pathogenesis of Shiga-toxin-producing E. coli in the 1990s. He says they saw Shiga-toxin-producing phage transfer between E. coli in response to sub-therapeutic levels of the antibiotic ciprofloxacin in vitro and in the intestines of mice.

"They do it in the laboratory," he says, "but it's hard to show it happens in the environment." He is convinced it does, though. "The potential for the creation of new pathogens via phage release is absolutely a factor in the broader environmental danger of overuse of antibiotics."

Agricultural use of antibiotics is a possible suspect. "Phage are particularly abundant in the guts of ruminants", says Alfredo Caprioli, from the European Reference Laboratory for verotoxin-producing E. coli in Rome, Italy (verotoxin is another name for Shiga toxin). And the gut is one place in which the phage move between different bacteria, and new pathogenic bacterial strains emerge.

Shiga toxins have been causing diarrhoeal disease in humans for centuries — the bacterial genus Shigella and the Shiga toxins were first named for Kiyoshi Shiga, a Japanese medical doctor who identified the bacterium during an outbreak of dysentery in Japan in 1897. According to Allison, Shiga-toxin producing phage probably picked up the genes encoding Shiga toxin from these bacteria, and since the 1980s have been spreading these virulent genes to other bacteria, including many strains of E. coli.

"We are seeing more and more Shiga-toxin-producing strains," says Alison Weiss, microbiologist at the University of Cincinnati in Ohio.

How have Shiga-toxin-producing phage spread so widely in just a few decades? Allison says they have unusual characteristics that make them very successful. They infect bacteria by binding to a protein called BamA on the surface of many bacterial cells, which gives them a broad range of hosts. Most phage can only infect a host cell once, but Shiga-toxin-producing phage can infect the same cell multiple times, giving them greater pathogenic potential. And they can survive outside their hosts, in water or soil, for example.

Weiss adds that carrying the phage also provides a survival advantage for the host bacteria. "Once the bacteria are out in the environment — say in manure — they are fed on by other microbes, such as protozoans. The toxins kill the other microbes, giving these bacteria an advantage."

Not only are more E. coli strains being infected with Shiga toxin, but it seems to be moving into different classes of bacteria. The genome of strain O104:H4 has been sequenced, and it shares many genes with enteroaggerative E. coli (EAEC) strains. "EAEC strains are not typically associated with zoonotic infections, and EAEC and Shiga toxin is a very unusual combination," says Caprioli.

This increased movement of Shiga-toxin-producing phage means that even more unusual and dangerous strains could be on the horizon.

http://www.nature.com/news/2011/110609/full/news.2011.360.html

Time up for relativity table-top test?

Nobel prizewinners clash over use of atoms as clocks to test Einstein's theory.
Eric Hand

US energy secretary Steven Chu has been caught up in an argument over just what can be considered a clock.Ron Sachs/Pool/CNP/Corbis

Can the time-warping ways of Einstein's theory of general relativity be measured by the quantum 'ticking' of an atom? In 2010, researchers at the University of California, Berkeley, claimed in Nature[1] that they had used an inexpensive table-top apparatus to show how gravity had altered a fundamental oscillation of two atoms. But a group of French researchers now say that these atomic oscillations don't work like clocks at all. "We found that these claims cannot be supported," says Luc Blanchet, a theorist at the Astrophysical Institute of Paris. Blanchet and his colleagues publish a critique[2] today in Classical and Quantum Gravity, alongside another paper[3] that independently criticizes the Berkeley researchers.

For decades, researchers have been putting general relativity to the test. The theory has held up so far, but any deviation from expectations, however small, could point to an overhaul of physics.

One much-tested aspect of relativity, 'gravitational redshift', explains how clocks run faster at higher elevations where gravity is weaker — an effect that has to be accounted for in the operation of global positioning system (GPS) satellites. The tests for this effect, using clocks in towers, airplanes and rockets, have become increasingly precise.

But the Berkeley researchers garnered acclaim by doing the experiment on a table-top, with their 'clocks' separated by a height of just 0.1 millimetres (see 'General relativity tested on a tabletop'). Nobel laureate Steven Chu, the US Secretary of Energy, was a co-author, which also helped to raise the paper's profile. The French team, however, is hitting back with a Nobel prize-winner of it own: Claude Cohen-Tannoudji, who shared the 1997 physics prize with Chu.

Clocking off

The debate comes down to whether a fundamental atomic oscillation, based on the rest mass of a caesium atom, can be used as a clock. The table-top setup relied on an atom interferometer, which tracked the offset in oscillations, or phase difference, of the caesium atoms as they flew on paths of marginally different heights. But Blanchet's team argue that the phase difference between any two atoms due to the fundamental oscillation will always be zero, and therefore could never be used to detect a gravitational redshift.

They say that the Berkeley researchers were instead using their interferometer as an accelerometer to measure a different aspect of general relativity: the universality of free fall. That is no less interesting in its own right, but it has already been tested to greater levels of precision.

Berkeley physicist Holger Müller, lead author of the Nature paper, stands by his claim, and, in April, published a paper[4] further explaining his team's approach. He says that the teams are engaged in semantic disagreements over what defines a clock. He is already at work on a new table-top setup that will eliminate the accelerating effect of gravity. If his caesium atoms still accumulate a phase difference, then it would be due to the gravitational redshift, not the universality of free fall.

Clifford Will, who studies general relativity at Washington University in St Louis, Missouri, says he thinks Blanchet and his team currently have the upper hand. "Their argument to me seems completely convincing," says Will, who was not one of the reviewers of the critiques, but was familiar with them as editor of Classical and Quantum Gravity.

If the critiques of the French team's findings hold up, they could bolster the mission goals of the Atomic Clock Ensemble in Space (ACES), a European Space Agency experiment that is slated to join the International Space Station in 2014. The experiment, which will perform important synchronizations of atomic clocks around the world, is also supposed to test the gravitational redshift effect — but is capable of far less precision than the table-top experiment. If the Berkeley results end up being as ghostly as the quantum oscillations on which they rely, the ACES team could take the lead as being Einstein's best clock-keepers.

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Underwater spiders use webs as 'gills'

Diving-bell webs act as oxygen exchangers, not just aqualungs.
Matt Kaplan

Argyroneta aquatica has no need to go back to the surface to replenish its air bubble.Oxford Scientific/Photolibrary

The diving-bell spider Argyroneta aquatica is unique in its ability to live most of its life underwater. But how does it make sure it always has enough oxygen? Scientists have now discovered that the underwater web it uses to store air is more than just a static diving bell — it can function in a similar way to fish gills by obtaining oxygen from the water.

The spider collects air from the surface in tiny hairs on its body and releases it underneath webs that it spins between underwater plants, forming its own air-filled diving bell. It was previously thought that the spider had to constantly refresh the air by taking frequent trips back to the surface.

However, it has been known for almost a century that air bubbles carried by certain diving insects can actively take up oxygen dissolved in the water, thus supplying much more oxygen than the original bubble contained. This led Roger Seymour at the University of Adelaide in Australia and Stefan Hetz at the Humboldt University of Berlin to question whether the spiders' diving bells could act in a similar way, taking up dissolved oxygen so that the spiders wouldn't always need to refill them with fresh air — exchanging dissolved oxygen rather like an artificial fish gill.

Because the spiders consume oxygen from the diving bell and expel carbon dioxide that dissolves rapidly into water, the team proposed that the decrease in oxygen concentration in the bell would cause oxygen to be taken up from the water. However, whether it was sufficient to meet the metabolic needs of the spider was not clear, as previous studies had revealed that the spiders constantly added more air from the surface.

Pressure probe

To test the idea, Seymour and Hetz collected spiders from the wild and kept them in aquaria in the lab. They then used oxygen-sensitive fibre-optic probes to measure the partial pressure of oxygen both in the diving bell webs and in the water 5-10 millimetres away from them, taking measurements when the spider was present and again when it was absent. By monitoring the rate of change of oxygen inside the bell and the volume of gas inside it, the researchers were able to determine how much oxygen entered the bell from the water as well as how much the spider consumed.

Seymour and Hetz report in The Journal of Experimental Biology[1] that partial pressures of oxygen did differ between the outside water and the diving bells, and that this drove oxygen to slowly flow into the diving bells. "We were surprised to find that diffusion of oxygen was high enough to cover the breathing needs of the spiders when they were at rest," says Seymour.

They also found that spiders that were larger or engaged in energy-intensive activities, such as egg laying or feeding, made their diving bells bigger to allow more oxygen to transfer across, just as growing animals enlarge their own lungs and gills.

The spiders also showed a remarkable tolerance to low oxygen levels, allowing the oxygen level in the diving bells to drop to 10–20% of the level in the atmosphere before venturing to the surface to grab a bubble of

fresh air. "Most insects are not happy below 4 or 5 kilopascals of oxygen," explains entomologist John Terblanche at Stellenbosch University in South Africa, "yet these spiders seem to be dropping to around 1 or 2 kilopascals without any obvious signs of distress."
Terblanche speculates that the spiders might have mechanisms at work in their bodies that allow them to use oxygen in a very efficient way. "This might be a particularly fruitful area for future research," he says.

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Computer security: Is this the start of cyberwarfare?

Last year's Stuxnet virus attack represented a new kind of threat to critical infrastructure.
Sharon Weinberger

Just over a year ago, a computer in Iran started repeatedly rebooting itself, seemingly without reason. Suspecting some kind of malicious software (malware), analysts at VirusBlokAda, an antivirus-software company in Minsk, examined the misbehaving machine over the Internet, and soon found that they were right. Disturbingly so: the code they extracted from the Iranian machine proved to be a previously unknown computer virus of unprecedented size and complexity.

On 17 June 2010, VirusBlokAda issued a worldwide alert that set off an international race to track down what came to be known as Stuxnet: the most sophisticated computer malware yet found and the harbinger of a new generation of cyberthreats. Unlike conventional malware, which does its damage only in the virtual world of computers and networks, Stuxnet would turn out to target the software that controls pumps, valves, generators and other industrial machines.

"It was the first time we'd analysed a threat that could cause real-world damage, that could actually cause some machine to break, that might be able to cause an explosion," says Liam O Murchu, chief of security response for the world's largest computer-security firm, Symantec in Mountain View, California.

Stuxnet provided chilling proof that groups or nations could launch a cyberattack against a society's vital infrastructures for water and energy. "We are probably just now entering the era of the cyber arms race," says Mikko Hypponen, chief research officer for F-Secure, an antivirus company based in Helsinki.

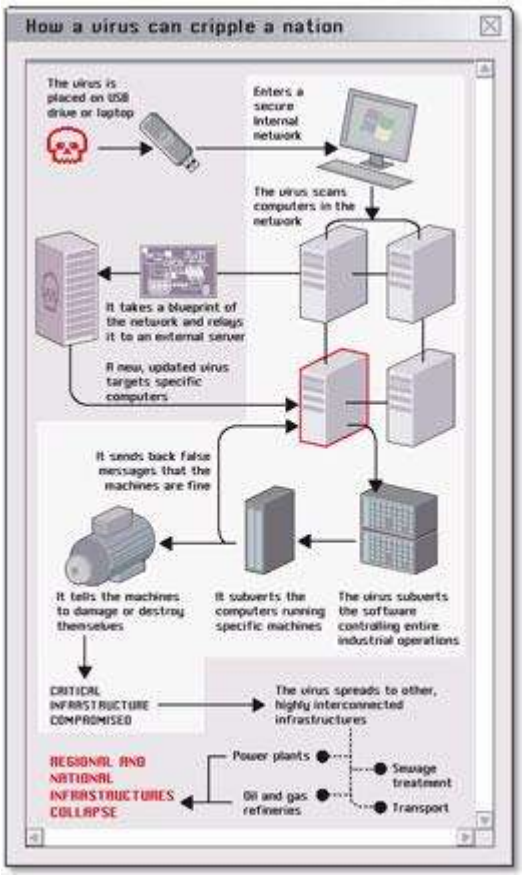
Worse yet, the Stuxnet episode has highlighted just how inadequate are society's current defences — and how glaring is the gap in cybersecurity science.

Computer-security firms are competitive in the marketplace, but they generally respond to a threat such as Stuxnet with close collaboration behind the scenes. Soon after VirusBlokAda's alert, for example, Kaspersky Lab in Moscow was working with Microsoft in Redmond, Washington, to hunt down the vulnerabilities that the virus was exploiting in the Windows operating system. (It was Microsoft that coined the name Stuxnet, after one of the files hidden in its code. Technically, Stuxnet was a 'worm', a type of malware that can operate on its own without needing another program to infect. But even experts often call it a 'virus', which has become the generic term for self-replicating malware.)

One of the most ambitious and comprehensive responses was led by Symantec, which kept O Murchu and his worldwide team of experts working on Stuxnet around the clock for three months. One major centre of operations was Symantec's malware lab in Culver City, California, which operates like the digital equivalent of a top-level biological containment facility. A sign on the door warns visitors to leave computers, USB flash drives and smart phones outside: any electronic device that passes through that door, even by mistake, will stay there. Inside the lab, the team began by dropping Stuxnet into a simulated networking environment so that they could safely watch what it did. The sheer size of the virus was staggering: some 15,000 lines of code, representing an estimated 10,000 person hours in software development. Compared with any other virus ever seen, says O Murchu, "it's a huge amount of code".

Equally striking was the sophistication of that code. Stuxnet took advantage of two digital certificates of authenticity stolen from respected companies, and exploited four different 'zero day vulnerabilities' — previously unidentified security holes in Windows that were wide open for hackers to use.

Then there was the virus's behaviour. "Very quickly we realized that it was doing something very unusual," recalls O Murchu. Most notably, Stuxnet was trying to talk to the programmable logic controllers (PLCs) that are used to direct industrial machinery. Stuxnet was very selective, however: although the virus could spread to almost any machine running Windows, the crucial parts of its executable code would become active only if that machine was also running Siemens Step7, one of the many supervisory control and data acquisition (SCADA) systems used to manage industrial processes.



Many industrial control systems are never connected to the Internet, precisely to protect them from malware and hostile takeover. That led to another aspect of Stuxnet's sophistication. Like most other malware, it could spread over a network. But it could also covertly install itself on a USB drive. So all it would take was one operator unknowingly plugging an infected memory stick into a control-system computer, and the virus could explode into action (see 'How a virus can cripple a nation').

Murky motives

It still wasn't clear what Stuxnet was supposed to do to the Siemens software. The Symantec team got a clue when it realized that the virus was gathering information about the host computers it had infected, and sending the data back to servers in Malaysia and Denmark — presumably to give the unknown perpetrators a way to update the Stuxnet virus covertly. Identifying the command and control servers didn't allow Symantec to identify the perpetrators, but they were able to convince the Internet service providers to cut off the perpetrators' access, rerouting the traffic from the infected computers back to Symantec so that they could eavesdrop. By watching where the traffic to the servers was coming from, O Murchu says, "we were able to see that the majority of infections were in Iran" — at least 60% of them. In fact, the infections seemed to have been appearing there in waves since 2009.

The obvious inference was that the virus had deliberately been directed against Iran, for reasons as yet unknown. But the Symantec investigators couldn't go much further by themselves. They were extremely knowledgeable about computers and networking, but like most malware-protection teams, they had little or no expertise in PLCs or SCADA systems. "At some point in their analysis they just couldn't make any more sense out of what the purpose of this thing was, because they were not able to experiment with the virus in such a lab environment," says Ralph Langner, a control-system security consultant in Hamburg, Germany. Langner independently took it upon himself to fill that gap. Over the summer, he and his team began running Stuxnet in a lab environment equipped with Siemens software and industrial control systems, and watching how the virus interacted with PLCs. "We began to see very strange and funny results immediately, and I mean by that within the first day of our lab experiment," he says.

Those PLC results allowed Langner to infer that Stuxnet was a directed attack, seeking out specific software and hardware. In mid-September 2010, he announced on his blog that the evidence supported the suspicion that Stuxnet had been deliberately directed against Iran. The most likely target, he then believed, was the Bushehr nuclear power plant.

Industrial sabotage

Speculative though Langner's statements were, the news media quickly picked up on them and spread the word of a targeted cyberweapon. Over the next few months, however, as Langner and others continued to work with the code, the evidence began to point away from Bushehr and towards a uranium-enrichment facility in Natanz, where thousands of centrifuges were separating the rare but fissionable isotope uranium-235 from the heavier uranium-238. Many Western nations believe that this enrichment effort, which ostensibly provides fuel for nuclear power stations, is actually aimed at producing a nuclear weapon. The malware code, according to Langner and others, was designed to alter the speed of the delicate centrifuges, essentially causing the machines to spin out of control and break.

That interpretation is given credence by reports from the International Atomic Energy Agency (IAEA) in Vienna, which document a precipitous drop in the number of operating centrifuges in 2009, the year that many observers think Stuxnet first infected computers in Iran.

“We are probably just now entering the era of the cyber arms race.”

True, the evidence is circumstantial at best. "We don't know what those machines were doing" when they weren't in operation, cautions Ivanka Barszashka, a Bulgarian physicist who studied Iranian centrifuge performance while she was working with the Federation of American Scientists in Washington DC. "We don't know if they were actually broken or if they were just sitting there." Moreover, the Iranian government has officially denied that Stuxnet destroyed large numbers of centrifuges at Natanz, although it does acknowledge that the infection is widespread in the country. And IAEA inspection reports from late 2010 make it clear that any damage was at most a temporary setback: Iran's enrichment capacity is higher than ever.

However, if Natanz was the target, that does suggest an answer to the mystery of who created Stuxnet, and why. Given the knowledge required — including expertise in malware, industrial security and the specific types and configurations of the industrial equipment being targeted — most Stuxnet investigators concluded early on that the perpetrators were backed by a government.

Governments have tried to sabotage foreign nuclear programmes before, says Olli Heinonen, a senior fellow at the Belfer Center for Science and International Affairs at Harvard University in Cambridge, Massachusetts, and former deputy director-general of the IAEA. In the 1980s and 1990s, for example, Western governments orchestrated a campaign to inject faulty parts into the network that Pakistan used to supply nuclear technology to countries such as Iran and North Korea. Intelligence agencies, including the US Central Intelligence

Agency, have also made other attempts to sell flawed nuclear designs to would-be proliferators. "Stuxnet," says Heinonen, "is another way to do the same thing."

Langner argues that the government behind Stuxnet is that of the United States, which has both the required expertise in cyberwarfare and a long-standing goal of thwarting Iran's nuclear ambitions. Throughout the summer of 2010, while Langner, Symantec and all the other investigators were vigorously trading ideas and information about Stuxnet, the US Department of Homeland Security maintained a puzzling silence, even though it operates Computer Emergency Readiness Teams (CERTs) created specifically to address cyberthreats. True, the CERT at the Idaho National Laboratory outside Idaho Falls, which operates one of the world's most sophisticated testbeds for industrial control systems, did issue a series of alerts. But the first, on 20 July 2010, came more than a month after the initial warning from Belarus and contained nothing new. Later alerts followed the same pattern: too little, too late. "A delayed clipping service," said Dale Peterson, founder of Digital Bond, a SCADA security firm in Sunrise, Florida, on his blog.

"There is no way that they could have missed this problem, or that this is all a misunderstanding. That's just not possible," says Langner, who believes that the Idaho lab's anaemic response was deliberate, intended to cover up the fact that Stuxnet had been created there.

But even Langner has to admit that the evidence against the United States is purely circumstantial. (The US government itself will neither confirm nor deny the allegation, as is its practice for any discussion of covert activity.) And the evidence against the other frequently mentioned suspect, Israel, is even more so. Symantec, for example, points out that a name embedded in Stuxnet's code, Myrtus, could be a reference to a biblical story about a planned massacre of Jews in Persia. But other investigators say that such claims are beyond tenuous. "There are no facts" about Israel, declares Jeffrey Carr, founder and chief executive of Taia Global, a cybersecurity consulting company in Tysons Corner, Virginia.

The Aftermath

The 'who?' may never be discovered. Active investigation of Stuxnet effectively came to an end in February 2011, when Symantec posted a final update to its definitive report on the virus, including key details about its execution, lines of attack and spread over time. Microsoft had long since patched the security holes that Stuxnet exploited, and all the antivirus companies had updated their customers' digital immune systems with the ability to recognize and shut down Stuxnet on sight. New infections are now rare — although they do still occur, and it will take years before all the computers with access to Siemens controllers are patched.

If Stuxnet itself has ceased to be a serious threat, however, cybersecurity experts continue to worry about the larger vulnerabilities that it exposed. Stuxnet essentially laid out a blueprint for future attackers to learn from and perhaps improve, say many of the investigators who have studied it. "In a way, you did open the Pandora's box by launching this attack," says Langner of his suspicions about the United States. "And it might turn back to you guys eventually."

Cybersecurity experts are ill-prepared for the threat, in part because they lack ties to the people who understand industrial control systems. "We've got actually two very different worlds that traditionally have not communicated all that much," says Eric Byres, co-founder and chief technology officer of Tofino Industrial Security in Lantzville, Canada. He applauds Symantec, Langner and others for reaching across that divide. But the effort required to make those connections substantially delayed the investigation.

The divide extends into university computer-science departments, say Byres, himself an ex-academic. Researchers tend to look at industrial-control security as a technical problem, rather than an issue requiring serious scientific attention, he says. So when graduate students express interest in looking at, say, cryptography and industrial controls, they are told that the subject is not mathematically challenging enough for a dissertation project.

"I'm not aware of any academic researchers who have invested significantly in the study of Stuxnet," agrees Andrew Ginter, director of industrial security for the North American group of Waterfall Security Solutions, based in Tel Aviv, Israel. Almost the only researchers doing that kind of work are in industrial or government settings — among them a team at the Idaho National Laboratory working on a next-generation system called Sophia, which tries to protect industrial control systems against Stuxnet-like threats by detecting anomalies in the network.

One barrier for academics working on cybersecurity is access to the malware that they must protect against. That was not such a problem for Stuxnet itself, because its code was posted on the web shortly after it was first identified. But in general, the careful safeguards that Symantec and other companies put in place in

secure labs to protect the escape of malware may also inadvertently be a barrier for researchers who need to study them. "If you're doing research into biological agents, it's limited groups that have them and they are largely unwilling to share; the same holds true for malware," says Anup Ghosh, chief scientist at the Center for Secure Information Systems at George Mason University in Fairfax, Virginia. "To advance the field, researchers need access to good data sets," says Ghosh, who was once a programme manager at the US Defense Advanced Research Projects Agency, and is now working on a malware detector designed to identify viruses on the basis of how they behave, rather than on specific patterns in their code, known as signatures.
Academic researchers are also inhibited by a certain squeamishness about digital weaponry, according to Herb Lin, chief scientist at the Computer Science and Telecommunications Board of the US National Research Council in Washington DC. He points out that to understand how to guard against cyberattacks, it may help to know how to commit them. Yet teaching graduate students to write malware is "very controversial", he says. "People say, 'What do you mean: you're training hackers?'"

Preparing for the next attack

A study last year by the JASON group, which advises the US government on science and technology matters, including defence, found broad challenges for cybersecurity (JASON Science of Cyber-Security; MITRE Corporation, 2010). Perhaps most important was its conclusion that the field was "underdeveloped in reporting experimental results, and consequently in the ability to use them".
Roy Maxion, a computer scientist at Carnegie Mellon University in Pittsburgh, Pennsylvania, who briefed JASON, goes further, saying that cybersecurity suffers from a lack of scientific rigour. Medical professionals over the past 200 years transformed themselves from purveyors of leeches to modern scientists with the advent of evidence-based medicine, he notes. "In computer science and in computer security in particular, that train is nowhere in sight."
Computer science has developed largely as a collection of what Maxion calls "clever parlour tricks". For example, at one conference, the leading paper showed how researchers could read computer screens by looking at the reflections off windows and other objects. "From a practical point of view, anyone in a classified meeting would go, 'pooh'," he says. "In places where they don't want you to know [what's on the computer screen], there are no windows. Yet, that was the buzz that year."
Maxion sees an urgent need for computer-science and security curricula to include courses in traditional research methods, such as experimental design and statistics — none of which is currently required. "Why does it matter?" he asks. "Because we don't have a scientific basis for investigating phenomena like Stuxnet, or the kind of defences that would be effective against it."

Also troubling for many of the Stuxnet investigators was the US government's lacklustre response to the virus (assuming that it was not the perpetrator). Stuxnet represents a new generation of cyberweapon that could be turned against US targets, but there is no evidence that the government is making the obvious preparations for such an attack — for example, plans for a coordinated response that pools resources from academia, research institutes and private business.

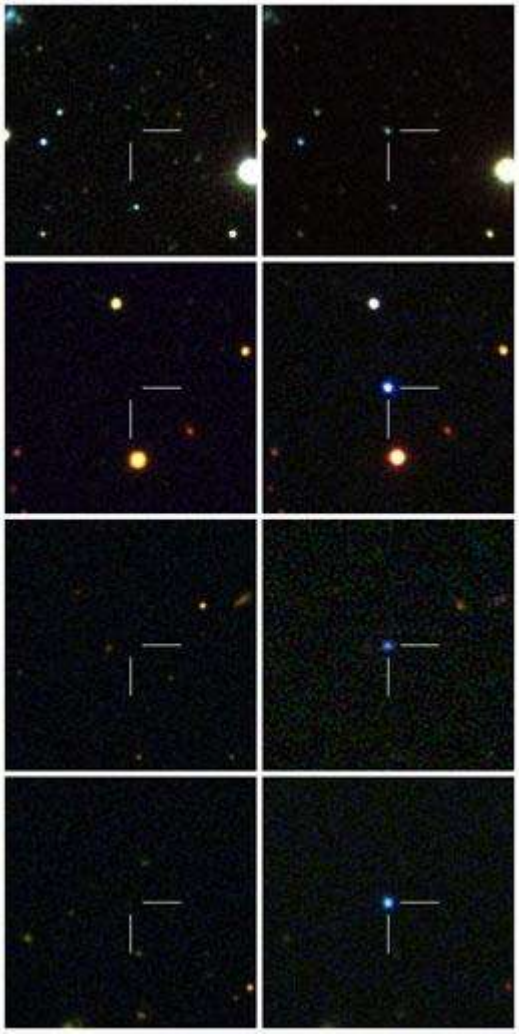
Other countries seem to be taking the threat more seriously. Some of China's universities and vocational colleges have reportedly forged strong connections with the military to work on cybersecurity, for example.

And Israel also seems to be exploiting its computing expertise for national security. A few months before the discovery of Stuxnet, Yuval Elovici, a computer scientist and director of Deutsche Telekom Laboratories at Ben-Gurion University of the Negev in Beersheba, Israel, told Nature that he was working closely with the country's Ministry of Defense on cybersecurity. He presciently warned that the next wave of cyberattacks would be aimed at physical infrastructures. "What would happen if there were a code injection into SCADA? What if someone would activate it suddenly?" Elovici asked. He and other experts have been warning for several years now that such an attack on SCADA systems controlling the electricity grid could spark nationwide blackouts, or that the safety systems of power plants could be overridden, causing a shutdown or a serious accident. Similar disruptions could hit water and sewage systems, or even food processing plants. Such attacks, Elovici warned, are both realistic and underestimated. Asked how bad one would be, Elovici was unequivocal. "I think," he said, "it would be much stronger than the impact of setting several atomic bombs on major cities."

http://www.nature.com/news/2011/110608/full/474142a.html

Brightest supernovae are in a class of their own

The Universe's biggest explosions can't be explained by current theories.
Jon Cartwright



The Type Ia supernova that created Tycho, pictured, was not nearly as bright as the new class just discovered.NASA/CXC/Chinese Academy of Sciences/F. Lu et al

Some of the brightest stellar explosions in the Universe should be classified together as a new type of supernova, according to an international collaboration of researchers. The group has catalogued six explosions that cannot easily be explained by any process yet known.

When stars several times more massive than our Sun die, they explode, forming supernovae. The process varies, but the result is a massive radiation of energy that can outshine an entire galaxy. Sometimes the radiation is produced by the radioactive decay of freshly generated elements, whereas in other cases it comes from an explosive release of heat or from a collision between debris ejected from the star and material surrounding it.

Robert Quimby, an astronomer at the California Institute of Technology in Pasadena, and his colleagues are presenting a new class of supernova that is not driven by any of these processes.

In a study published online today in Nature[1], the researchers describe four previously unidentified supernovae, along with two known events that had confounded astronomers: SN 2005ap, which in 2007 was identified as the brightest supernova ever detected[2], and SCP 06F6, which made headlines in 2008 because it had a spectrum that didn't match any known types of supernova[3].

Before and after images of four hydrogen-poor superluminous supernovae discovered by the Palomar Transient Factory. In each case, the supernovae shine far brighter than all other stars combined in their host galaxies.Caltech/Robert Quimby

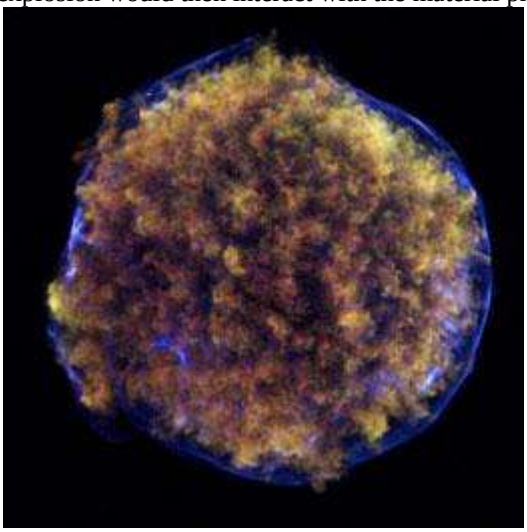
The supernovae in the new class have several distinguishing features. One is that they are very bright — about ten times more luminous than type Ia supernovae, the most commonly recorded type. Another is that their main emission is not visible light, as for most supernovae, but ultraviolet radiation.

Unrivalled power

The question is what causes their brightness. In type Ia supernovae, the lasting glow comes from the radioactive decay of isotopes such as nickel-56. But Quimby's group doesn't think that this is the case with the new supernovae, because their ultraviolet light fades away about three times too fast to match the rate of nuclear decay.

The light could come from the explosion itself, but the researchers say that the sheer brightness would require the star to give off an "unrealistic" amount of energy. The only remaining conventional explanation — that the light is generated in interactions between debris from the star and hydrogen-rich surrounding material — seems unlikely because the light that they emit shows no indication of the presence of hydrogen.

Perhaps, says Quimby's group, the exploding stars were so big — say, 100 times the mass of our Sun — that they would become very unstable, throwing off bits of material before their final explosion. That final explosion would then interact with the material previously cast off, producing a dazzling light show.



On the other hand, the early stages of the supernovae might have created spinning, highly magnetized neutron stars or 'magnetars'. The very strong magnetic field of such stars would slow down their spin, and the excess energy of their motion would be released to make the supernovae unusually bright.

The process is likely to be debated for some time. "The death of very massive stars is still quite uncertain," say Hideyuki Umeda and Ken'ichi Nomoto, astronomers at the University of Tokyo. "How mass is ejected from these stars, and how long before the explosion, is still unknown and a controversial issue."

But the new supernovae don't have to be assigned to a named class to be useful to astronomers. Their extreme brightness means they should illuminate distant parts of the Universe, perhaps literally shedding light on the formation of very faint dwarf galaxies.

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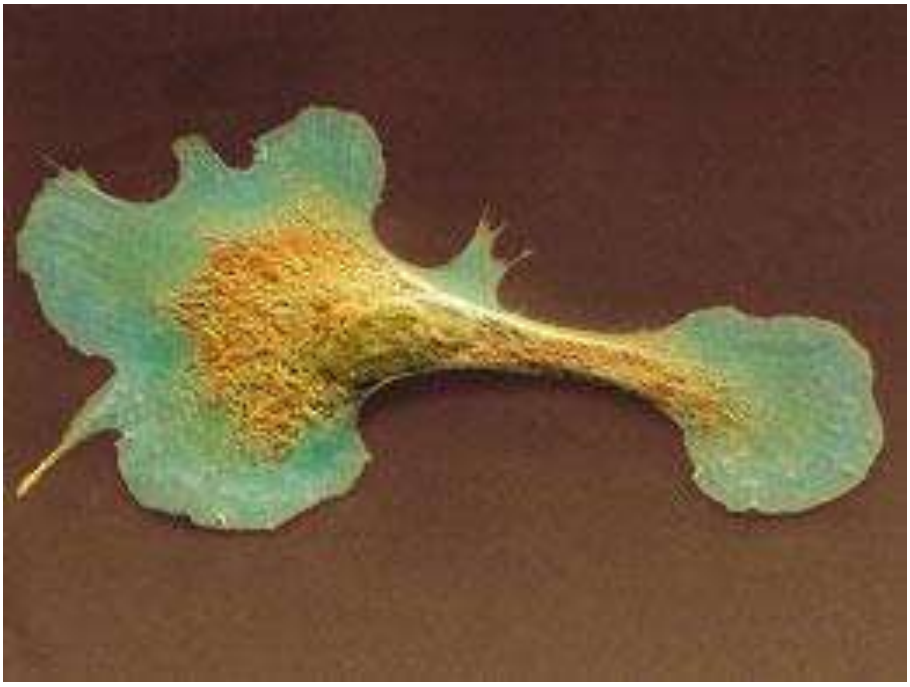
http://www.nature.com/news/2011/110608/full/news.2011.354.html

Stem cells patch up 'broken' heart

Cell reactivation in mouse hearts repairs muscle after heart attack.
Marian Turner



Cardiomyocytes cannot repair themselves after heart attacks.THOMAS DEERINCK, NCMIR/SCIENCE PHOTO LIBRARY

Time might be enough to heal a heartbreak, but an injured heart can rarely repair itself. However, a study published today in Nature[1] reports that a natural protein can activate stem cells in mouse hearts to replace damaged tissue with new muscle cells.

Heart muscle cells, or cardiomyocytes, are irreparably damaged by heart attack. For the heart to continue functioning properly, the damaged cells must be replaced. Heart progenitor cells — cells that can form the various tissues that make up the heart, such as blood vessels and muscle — do exist, but in adults are not active enough to repair damage. So Paul Riley at University College London Institute of Child Health and his colleagues have found a way to wake them up.

Riley and his team used a small protein called thymosin β4 (Tβ4), which is found in many tissues and regulates cell structure and mobility. They had already shown that Tβ4 can induce heart progenitor cells to produce new blood vessels[2]. This time, they were looking for new muscle.

Express delivery

"We studied the activity of a gene called Wt1, because we know that embryonic stem cells expressing Wt1 can become cardiomyocytes, but Wt1 is switched off in adults," says Riley. He and his team injected mice with Tβ4 every day for a week, then anaesthetized the animals and stitched together one of their arteries, mimicking a heart attack. Mice survive this procedure, making it possible to study the way their hearts respond to treatment.

The researchers examined the hearts of mice at various time points after the operation. They found heart cells expressing Wt1 just two days after the injury. The cells were initially in the heart's outer layer, but by two weeks after surgery they had moved inside and clustered around the site of the injury. The cells had also changed in size and shape, and looked just like cardiomyocytes.

Riley and his team are still working out exactly how Tβ4 switches stem-cell genes in the heart cells back on, but they're betting on an epigenetic effect — a chemical change to DNA that affects gene expression. They

think that the injury provides a trigger for the stem cells to go ahead and divide, making healthy new muscle cells. The researchers are also trying to work out what that injury signal actually is.
Maurice van den Hoff, a cardiac biologist at the Heart Failure Research Center in Amsterdam who was not involved in the study, says that lipid or bone-marrow stem cells have been used in heart-attack patients before, but that these stem cells don't make true cardiomyocytes, so they won't work in patients long-term. "But heart stem cells are much more likely become the right cell type, and lead to lasting repair," he says.

Wear and repair

Riley thinks that Tβ4, or another molecule of similar effect, might become a daily preventative treatment for people who have a family history of heart disease, much as cholesterol-lowering drugs and anti-clotting agents have done. But Deepak Srivastava, a cardiac stem-cell biologist at the Gladstone Institute of Cardiovascular Disease in San Francisco, California, who was not part of the study, says a daily treatment is best given as a pill, and proteins such as Tβ4 usually have to be delivered by injection.

Instead, he sees another possibility for the treatment. His group previously showed that treating mice with Tβ4 within hours of a heart attack helps muscle cells survive the injury[3]. Srivastava and his co-workers are now working with RegeneRx Biopharmaceuticals of Rockville, Maryland, to test Tβ4 injections in humans, and the drug has already passed safety trials. The next phase of the drug trials might change in light of the new findings, which suggest that Tβ4 might continue to prime stem cells to make new cells after its initial survival effect has worn off. "Maybe we will inject for longer than 3 days," Srivastava says.
Although further experiments and clinical trials are needed to show whether Tβ4 works the same way in human hearts, and whether treatment is most effective before or after a heart injury, the scientists agree that self-repair is the best medicine for a broken heart.

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Hepatitis C mouse model a major milestone

Development paves the way for testing potential vaccines.
Virginia Gewin

Hepatitis C relies on specific 'host entry factors' to infect cells - making it impossible to study the disease in lab mice until now.Elie Dolgin

Researchers have produced the first mouse model with a functional immune system that is susceptible to infection by the hepatitis C virus — by getting it to express two human genes.

The advance paves the way for testing potential vaccines and drug targets. With few therapies available — the first targeted ones were approved by the US Food and Drug Administration just last month — the hepatitis C virus (HCV) puts 170 million people around the world at a heightened risk of cirrhosis, liver failure and cancer.

HCV infects only humans and chimpanzees, using specialized molecules found in these organisms to establish infection. It is this specificity that has made it so difficult to develop treatments, because mice and other common laboratory animals are resistant to the virus.

Previously, researchers had humanized mice by engineering them to support human liver cells[1]. In order for this to work, however, the mice had to be immunodeficient, which led to other problems. "Mice with human livers require much technical expertise, take several months to produce and do not have an adaptive immune system," says Karl-Dimiter Bissig, a stem-cell biologist at Baylor College of Medicine in Houston, Texas, who was not involved with the new work.

So Alexander Ploss, a virologist at the Rockefeller University in New York City, and colleagues decided that the key to a robust mouse model of HCV would be to provide the mouse cells with the human components necessary to take up the virus.

Entry granted

Over the past 13 years, several molecules, dubbed 'host entry factors', have been identified as essential for efficient viral uptake. To trick mouse cells into granting HCV entry, the team delivered the genes for up to four human entry factors into the cells using modified adenoviruses — common cold viruses.

The expression of just two of these human genes proved sufficient to make mouse cells susceptible to HCV. The results are published today in Nature[2].

"This new model is elegant in its simplicity," says Bissig. "Simply by overexpressing two proteins, they've created the first situation in which hepatitis C encounters a mouse immune system."

The research community has been eagerly anticipating this advance. "Although this step was expected given the vast amount of previous work that has been done to define entry factors, it's still an impressive step forward," says Michael Gale, an immunologist at the University of Washington in Seattle.

And the mice are not the only recent development in this area: the host factors required for HCV entry have already opened the door to new antiviral strategies. In April, Thomas Baumert, a virologist at the University of Strasbourg in France, and his colleagues reported the identification of two further factors that facilitate HCV entry in humans[3]. By blocking the molecules pharmacologically in a chimaeric mouse model his group inhibited infection.

Illuminating approach

Despite the excitement, the new mouse model does present one problem, says Gale — it is not yet very robust. "At this current stage it is not amenable to biochemical analyses of virus–host interactions because viral replication is so low," he says.
In working to overcome this expected limitation in mice with functioning immune systems, the authors created a sensitive detection system. As soon as the virus enters a cell — before it starts to replicate — it triggers the expression of a reporter gene that can be detected by luminescence. Ploss says that, without the reporter system, the team couldn't have made the progress they did.

Not surprisingly, Ploss has his sights set on achieving full viral replication in this mouse model to strengthen its ability to assess immune responses to potential vaccines.
His team is pursuing two possibilities. First, they are trying to identify any additional human factors that may be required to establish replication in mouse cells. And they are testing whether the viral entry signalling pathways somehow limit virus replication in mouse cells — to see whether they can disrupt target genes to create conditions more conducive to replication. Gale says these are important steps towards realizing what he expects will become a robust mouse model for HCV infection.
And the approach may find uses in other research areas. "This work does raise the hope that genetically humanized mouse models could become available for other viral infections, such as hepatitis B or HIV," says Baumert.

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The True Significance of 'Gainful Employment'

June 13, 2011
WASHINGTON -- A din of commentary surrounded the release this month of Education Department regulations designed to ensure that vocational programs prepare their students for gainful employment. Leaders of for-profit colleges -- and their supporters, mostly Republicans, in Congress -- continued to rattle their swords about the rules' fundamental unfairness in singling out for-profits for scrutiny. Meanwhile, Wall Street analysts and others who watch the sector -- and were free from worry about maintaining the colleges' position in a potential lawsuit challenging the regulations -- acknowledged just how much gentler the new rules were than the earlier version.
And the consumer advocates and Congressional Democrats who had urged the department to take a hard stand on for-profit-college regulation could not hide their disappointment with the agency's backtracking, even as they tried not to criticize department officials publicly.
Largely lost in the instant analyses, pro and con, though, was the long-term significance of the department's actions. The "gainful employment" rules, as they have come to be known, represent a powerful and potentially game-changing shift in how the federal government looks at higher education. The agency has written into federal policy, for the first time, a direct (if crude) attempt to measure the *value* of an academic program, by linking a measure of student expenditure (student loan debt burden) with an outcome measure (graduates' average income).
This current approach applies only to non-liberal-arts programs at for-profit colleges and to vocational non-degree programs at public and private nonprofit colleges -- for the moment. But now that the federal government has such a tool, many observers agree, it's hard to imagine that it won't seek to apply it more broadly -- if not this administration or Congress, then a future one.

New Direction

The extent to which the gainful employment rules represent a stark break with past approaches was evident from the moment the Education Department first mentioned the possibility of using them, which came in late 2009 during negotiations over a broad set of possible rules aimed at ensuring the integrity of federal financial aid programs.
When federal negotiators floated the idea of formally defining, for the first time, the "gainful employment" phrase that had been in the Higher Education Act for decades, college officials of all types balked, suggesting that doing so would exceed the department's regulatory authority.
"You can Google 'gainful employment,' " Anne Gross, vice president of regulatory affairs at the National Association of College and University Business Officers and one of the negotiators, said during a negotiated rule making session in 2009. "It's something that's been used for years and has a fairly well-understood definition. It's been used in the Higher Education Act for 40 years without difficulty." (Providing "an eligible program of training to prepare students for gainful employment in a recognized occupation" is one of the criteria an institution must meet to qualify to award federal financial aid as a "postsecondary vocational institution.")
Gross added: "I'm just kind of amazed at the path that we're going down without any statutory authority to do so that I can see…. Congress is not shy about being quite prescriptive in what it puts in the Higher Education Act, and to think that Congress put in gainful employment 40 years ago because they thought it would be a good idea for us to sit here ... and write pages and pages of formulas and regulations to define it just kind of blows me away."
She was far from alone in that thinking, among officials of nonprofit and for-profit colleges alike. Yet while the department estimated that public and private nonprofit colleges sponsored the vast majority of programs that would be covered by potential new rules, the estimates also showed that the for-profit-college programs would be disproportionately hurt by the department's proposed method of implementing them.
So while leaders of and lobbyists for traditional colleges balked loudly at some of the Education Department's other program integrity regulations -- notably those that establish a federal definition of "credit hour" and expand state authorization requirements -- they generally either supported, or at least kept quiet about, the gainful employment rules. That framed the debate over the gainful employment rules, on all sides, almost entirely as about government regulation of for-profit colleges.

As that debate unfolded, paralleled by a high-visibility investigation into commercial colleges by Senate Democrats and by intense lobbying against the rules by advocacy groups for the institutions, the department staked out an aggressive position in its first draft of the rules last July. The proposed regulation gave vocational programs whose students received federal financial aid two ways to prove that they were preparing graduates for gainful employment: by hitting a federal student loan repayment rate of at least 35 percent, or a debt-to-income ratio of less than 12 percent or a debt-to-discretionary-income ratio of less than 30 percent. Only 40 percent of the 55,000 programs covered by the rule were projected to meet the standards, with about 5 percent losing eligibility for aid and the other 55 percent forced to limit enrollments or make other changes.
For-profit colleges unleashed a furious lobbying campaign that characterized the government's regulatory approach as an effort to kill the sector. Although Education Department officials insisted that was not the case, and that their aim was to reform the behavior of "bad actors" in all college sectors, their inconsistent messaging -- along with the intensely anti-for-profit tone of the closely coordinated campaign in the Senate and the rhetoric of consumer advocacy groups with which the administration was closely allied -- helped create the impression that the department had a broader anti-for-profit bias.
That perception, along with the colleges' wooing of minority organizations and lawmakers, helped for-profit colleges expand their traditional base of Republican support in Congress; when the House of Representatives voted in February on a measure to block the Education Department from using federal funds to implement the gainful employment rules, 58 Democrats joined a united Republican majority in support of the bill.
That political reality -- along with threats of a lawsuit to block the rules that many legal observers saw as credible -- put intense pressure on the Obama administration to show that its officials had seriously considered the many objections raised by critics of the draft regulation, both to build a potential defense in a lawsuit and to try to win over enough skeptical members of Congress to avoid a blockade.
In unveiling the new rules this month, Education Secretary Arne Duncan repeatedly stated that department officials had "listened to lots and lots of folks" and tried to take a "thoughtful and reasonable" approach; it was not hard to hear his comments as a trial run for testimony at a potential lawsuit challenging the department's regulatory approach.

Softer But Still Striking

The end result -- unveiled by the department on June 1 and formally published today in the *Federal Register* -- inarguably softened the department's approach, by its own admission. (An earlier article on *Inside Higher Ed* lays out the various differences between the two versions and the ways in which it will make it easier for vocational programs to pass muster.) While many for-profit-college officials (and some of their supporters in Congress) continued to criticize the rules as unfair, others credited the department for the concessions it had made.
"While we do not yet know the full impact of the gainful employment rule, the Obama administration deserves real credit for having responded to a number of important comments and for having made improvements to the rule," said Jonathan A. Kaplan, president of Walden University, whose programs -- most of which are at the graduate level -- may fare better because of some of the changes the department made in the final rule.
Many of the strongest advocates for the Education Department's regulation of for-profit colleges said the department had backed down too much, with Campus Progress, a left-leaning student group affiliated with the Center for American Progress, arguing that the final gainful employment rule "lets many schools off the hook."
"I understand compromise, but this is not a minor tweak, some Solomonic revision of competing interests," Barmak Nassirian, associate executive director of the American Association of Collegiate Registrars and Admissions Officers, said in an interview. He argued that the department had now set the bar for full compliance so low that the Obama administration will have put its stamp of approval on practices that many critics of for-profit higher education -- and some administration officials -- have long challenged.
"One could argue that it now implicates the Obama administration in the mess that it found as a result of the Bush administration's terrible policies" on for-profit colleges, Nassirian said.
But other observers said they believed criticisms like that failed to recognize just how big a change the department has made by putting in place a new regulatory mechanism such as gainful employment. While the government made a start in this direction in the late 1980s by holding colleges accountable for their student loan default rates, gainful employment goes much further. By tying the debt a vocational program's students

accumulate to the income they eventually earn, gainful employment gives federal officials their first-ever tool for measuring the value of academic programs in terms of income and employability, said Anthony P. Carnevale, director of Georgetown University's Center on Education and the Workforce.

"People have made this a political fight when it's really a systems change," he said. And while he said he understands why fans of aggressive regulation might be disappointed by the department's backtracking, "on something like this you go slow, because we have to learn our way into the system."

For-profit colleges, meanwhile, are "crazy" not to go along with the government's final version of the rules, Carnevale said, because the regulations give them the "ability to cherry-pick which programs they want to have," with the chance to focus on those that are profitable and produce graduates who are employable. "If [for-profit colleges] can't pick the ones that make them money and figure out how to outrun the publics, then they're really not very good at what they do," he said.

Carnevale also said he believes the new rules have "much broader implications for higher education." One way or another, the idea implicit in gainful employment -- that in an era when the government is "shoveling money out" to higher education, "students have right to know what the outcome is in terms of employability" -- is likely to be applied to all programs and institutions, he said.

For-profit-college officials and their backers in Congress have consistently argued that the scrutiny the department has focused on their institutions should be applied broadly; "we support the administration in its efforts to create policies that improve overall institutional accountability – and we continue to believe that such policies should apply to all institutions of higher education, be they public, private nonprofit, or for-profit," Kaplan, of Walden University, said via e-mail.

Holding liberal arts or other traditional college programs accountable for the labor market outcomes of their graduates doesn't necessarily make sense, given that "for a lot of programs out there, there just isn't a tight linkage between the program and the expected jobs," said Donald E. Heller, professor of education and director of the Center for the Study of Higher Education at Pennsylvania State University.

And Education Department officials say they have no plans to employ the gainful employment metrics for non-vocational institutions.

"We're concerned about the problems of unaffordable debt or inconsistent quality at all institutions, and particularly with the Pell Grant situation we're in, there's a compulsion to be sure every dollar we're spending is spent well," an administration official said in an interview.

"But that doesn't mean that the same tools would be appropriate to use for all institutions, or that these are the right outcomes to be thinking about. It's a little clearer [for these vocational programs] that the intended benefits of programs are supposed to be monetary" than it would be for many liberal arts or other programs at traditional institutions.

That may be, said Kevin Carey, policy director at Education Sector, a Washington think tank. But the program-level salary data that the Social Security Administration will produce for the Education Department as part of gainful employment, he said, puts higher education "on the cusp of a new era of widely available data about how much college graduates earn and what kind of jobs they take."

"It just seems like a huge camel's nose under the tent of post-graduation outcomes," he said via e-mail. "Once a government agency starts gathering certain kinds of data and asking certain kinds of questions, it never stops. The hard part is getting the machine up and moving, but once it moves, inertia takes over."

— Doug Lederman

http://www.insidehighered.com/news/2011/06/13/explaining_the_true_significance_of_gainful_employment_rules

Imagining Starting from Scratch

June 13, 2011
ALEXANDRIA, Va. -- After reviewing accrediting agencies by using criteria so detailed that they were frequently described as "granular," the Education Department's National Advisory Committee on Institutional Quality and Integrity switched to the opposite extreme at its meeting late last week. The committee offered suggestions for an overhaul of the nation's accreditation system that dealt exclusively in broad ideas, including moving away from a regional approach to accreditation and ending the agencies' role as gatekeepers of federal student aid.
In December, the Education Department asked the committee, known as NACIQI (pronounced nuh-SEE-kee), to make recommendations for the 2013 renewal and revision of the Higher Education Act. The recommendations will be nonbinding -- they must pass through the Education Department and then Congress before becoming law, a long and uncertain road -- and they started from a thought exercise: members were told to imagine they were starting from scratch in designing the country's decentralized and in some ways byzantine higher education accreditation system. The committee began its discussion at a meeting in February, and continued it here late last week.
One thing was clear: if the committee really were able to start from scratch, the system would look a lot different. "No one would design this approach," said Marshall Hill, executive director of Nebraska's Coordinating Committee for Postsecondary Education, who contributed to a panel discussion about the respective roles of accreditors and state and federal governments in ensuring quality. Many members seemed to agree.
As it prepares to submit written policy recommendations to Education Secretary Arne Duncan at the end of this year, the committee has stretched beyond its usual focus. NACIQI's primary role is reviewing accrediting agencies and making recommendations to the Education Department about which ones deserve federal recognition. Since colleges must be accredited by a federally recognized agency for their students to receive Pell Grants, federal student loans and other financial aid, NACIQI has traditionally played an obscure but important role.
Branching out into suggesting legislation, including some provisions unrelated to accreditation, is new ground for the committee. In a wide-ranging discussion about data collection, the role of state and federal governments, and the benefits and drawbacks of regional accreditation, committee members (and, to a lesser extent, the witnesses they invited to speak) largely agreed on two broad points.
First, many members urged a move toward a system of accreditation based on the institution's type or sector rather than geographic location, so that community colleges would no longer judge research universities (or vice versa) in the peer review process that is at the core of the accrediting process. Such a system would allow institutions to more directly compare graduation rates and other outcomes, proponents argued.
"It's not going to be easy, but I think certainly the research institutions ought to be handled differently from trade schools and differently from community colleges," said Arthur Rothkopf, the president emeritus of Lafayette College and a member of the accrediting panel.
Chief among the proponents of this line of thinking was Princeton University's president, Shirley Tilghman, who has advocated for a switch to sector-based accreditation. Princeton clashed with the Middle States Commission on Higher Education, its regional accreditor, during its last evaluation: although its accreditation was renewed, the accreditor requested a progress letter dealing with student learning outcomes, using criteria that university officials and faculty found to be too narrow. Tilghman described the experience as "sobering."
"Peer review requires peers," Tilghman said, arguing that institutions can learn best from those "with the same backgrounds and the same experiences in higher education." As an example of how regional accreditation can lead to strange bedfellows, she cited Princeton's closest neighbor, Mercer County Community College. "It is a very fine community college. It serves the student population it serves exceedingly well," she said. "But I have nothing in common with Mercer County Community College.... There is so little that we have to say to each other, other than that we reside within the same county."
Others on the committee pushed back, asking how sector-based accreditation would break down beyond the most clear-cut decisions. While it might be easy to separate community colleges, elite research universities and for-profit institutions, they said, other divisions were less obvious.

"The development for sectors is a little more complicated than we might like," said Terry W. Hartle, senior vice president for government and public affairs at the American Council on Education. "The standards we might use at a place like Lafayette might be different than at a Christian college, where inculcation into values of faith is a central part of the institution's mission."

Other members and some panelists said that what Tilghman presented as a drawback was actually a benefit: without the work they do through their regional accreditor, they said, would Mercer County Community College and Princeton ever meet, and learn from one another's practices?

"I would be very concerned if we create a tiered system where all the elite institutions compete with the other elite institutions," said Arthur Keiser, chancellor and founder of the Keiser Collegiate System, a college chain in Florida. His institutions are accredited by the same regional accreditor as Duke University, he added: "I think we all benefit from that."

Eliminating the Gatekeeping Role

The committee also discussed a second theme that would even more radically reshape accreditation: separating accreditors' role in assessing the academic quality of institutions, for self-improvement purposes, from their federally ordained function as the gatekeepers for federal financial aid.

Many committee members agreed to some extent that accreditors were better suited to the first task than to the second, which the government layered onto their responsibilities decades after they began. The fact that the agencies have only one true disciplinary measure, cutting off access to federal financial aid, may be a handicap because it is so drastic, they said.

"I think the accreditation piece can be very good in terms of an academic process of self-improvement; that indeed is where it works very, very well," said Anne Neal, president of the American Council of Trustees and Alumni, who is an advocate of completely reshaping accreditation. "By putting the enforcement hat onto them, it has made it very difficult for peer review teams to be honest and actually do the kind of robust review of strengths and weaknesses."

But while many committee members said accreditors should focus more on academic quality and less on federal enforcement, none had easy answers for who or what would take on the enforcement role, when other members pressed for those details.

"If we take the enforcement role out of accreditation, where do we put it?" said Susan Phillips, chairwoman of the subcommittee focusing on legislative recommendations and provost and vice president for academic affairs at the State University of New York at Albany.

Neal outlined a system in which institutions would disclose data on graduation rates, student outcomes and other measures, which she said would give consumers enough information to make judgments about institutional quality for themselves, with penalties for institutions that did not comply. Others said they doubted that would be enough to replace the current system.

"I think there's this real lack of clarity from my perspective about what role the federal government would choose to take on," Cameron Staples, the committee's chairman and a state legislator from Connecticut, said in summing up the discussion.

Whatever the committee decides, it is a long way from becoming law: members said they planned to discuss and vote on a draft of their recommendations at a meeting in December. The document would then go to the Education Department and then to Congress -- where, of course, anything can happen.

When asked during the meeting, members had more ideas for improving the system than comments on what it does well. Still, some had words of faint praise.

"The triad does get the job done now," said William Pepicello, president of the University of Phoenix, referring to the trio of accreditors, state governments and the federal government. "It gets it done unartfully. It's often a labyrinth, and it has some overlapping pieces to it. But eventually it gets done all the things we want to get done."

— Libby A. Nelson

http://www.insidehighered.com/news/2011/06/13/u_s_panel_brainstorms_about_possible_changes_to_higher_education_accreditation

Teaching Them How to Think

June 9, 2011
WASHINGTON -- By any reasonable measure, George Plopper is a skilled and successful teacher.
The associate professor in the Department of Biomedical Engineering at Rensselaer Polytechnic Institute won awards for his teaching in 2000 and 2001 when he was still at the University of Nevada at Las Vegas (and in 1993 as a graduate student at Harvard University). As a result of his recognition at UNLV, Plopper found himself invited to a summer program in 2004 designed to improve the teaching of science on the undergraduate level.
That's where he first encountered Bloom's Taxonomy -- the oft-cited and much-revised classification of levels of thought and learning, which span from the lower levels of basic memorization to the more complex evaluation and creation of knowledge. While those in attendance at the 2004 session casually bandied about Bloomian terms -- including synthesis, comprehension and metacognition -- the jargon left Plopper confused. But after figuring out how to apply it to his own style of teaching, he started to embrace it.
He now applies Bloom to two of his upper-level courses at RPI, and in the process, Plopper said, he has dramatically changed his approach to teaching and to determining what his students learn. No longer content to lecture from the front of the room and convey a series of complicated facts about cancer biology and extracellular matrix interactions, Plopper now makes the process and expectations of learning an explicit part of the syllabus. In effect, he has changed his teaching, and made assessment part of the learning process -- for both himself and his students.
Under his new class format, Plopper asks his students to sort through the subject matter, digest it, and teach it to one another, and he puts students in real-world scenarios they might encounter as scientists. Both of these exercises, he says, force students to harness and analyze information in ways they never truly had to do when he asked them to attend his lectures, deliver a presentation of their own, and take a final exam.
“An A in my class is a very different A than it used to be,” Plopper said Wednesday during a session here at the annual meeting of the American Association of University Professors. “An A carries a much higher expectation of your ability to think."
Plopper backs up this assertion by charting what his students do on a grid on which Bloom's Taxonomy is mapped. He can identify, quantify and document the instances -- whether in an exam, class discussions or a presentation -- in which his students have demonstrated the kind of learning that goes beyond memorization up to higher order thinking. Students don't merely recite, but engage in something more difficult and ambiguous: exercising judgment in the face of uncertain or contradictory sources of information.
As a scientist, Plopper also uses the scientific method to guide his own teaching. And he's a stickler for the method, too, hewing to the definition of a hypothesis as "a proposed explanation for an observed set of facts." In the context of his teaching, his hypothesis is that if you use Bloom's Taxonomy to generate higher orders of thinking, you'll observe more of that thinking. While the hypothesis may strike some as elementary, Plopper also said that he had been less effective in drawing out such thinking in his students before he crafted it. He has also checked his data against his hypothesis, which he says has helped keep him honest in assessing the results of his instructional abilities.
Plopper's presentation on Wednesday, along with other sessions on assessment at this year's meeting, point to the increasing investment of faculty in the subject of assessment -- even at general meetings of academics like this year's gathering of the AAUP -- though some in the professoriate have traditionally viewed it with some skepticism. Other recent examples include a policy statement on assessment from the American Federation of Teachers and a report in which representatives of the three major academic unions expressed support for the idea of greater faculty involvement in the discussion. Still, for all Plopper's evident success, his experience -- and the comments of experts at other sessions -- suggest that pitfalls abound, and that progress is perhaps the byproduct of individual efforts more than the result of systemic priorities.
While teaching is one of three criteria, with research and service, on which most tenure and promotion decisions are made, several speakers on Wednesday noted that institutions offer few rewards to faculty who vigorously rethink assessment and how it can productively inform teaching.
One strategy, said Pat Hutchings, senior associate at the Carnegie Foundation for the Advancement of Teaching, is to treat assessment as a form of scholarship that should be recognized in the tenure and

promotion processes. It should also be linked more clearly to teaching and learning, she added. On its own, many speakers agreed, assessment has been seen as the domain of administrators, think tanks and foundations, when, in reality, it should be a natural part of the educational process that is guided by faculty.
"Assessment means asking if students are learning what I think I'm teaching," said Hutchings. "My sense is that what we need to think about now is how faculty can take back assessment. It's been possessed by others, if you will."
In his session, Plopper acknowledged that faculty members aren't always interested in the subject, especially if it means learning a new way to teach. Most have been teaching a particular way all of their professional lives, using a model observed since they were children, and most think it works well -- though Plopper argued that familiarity is not necessarily the same thing as effectiveness.
"They're not required to do this, so they don't," he said, referring to professors and the process of doing a wholesale re-examination of their teaching. "You've got to get tenure -- and you don't get tenure for using Bloom's Taxonomy, so why bother?"
For years, Plopper did much the same thing. He lectured. "I was delivering facts, concepts and sometimes methods and asking them to remember them, apply them and tell them back," he said. "They did brilliantly. They knew the rules.... They've been doing this since they started school." And this is where assessment comes into play.
Plopper said he started feeling increasingly uneasy about whether his students were truly understanding on a deep level what he was teaching them. So he reconfigured his two upper-level courses, each of which has about 30 students (he still teaches larger introductory biology in a standard lecture format), and changed his assumed role. Now he does not lecture as much as provide guidance. "I call it teaching it from the audience," Plopper said. "They execute their learning outcomes. My job is to make sure they don't fall off the rail."
What Plopper does now is not terribly rare in the realm of educational practice, particularly at the K-12 level, where it's commonly referred to as "project-based learning." Such a method requires students to take on more complicated, multifaceted tasks that require them to deploy different skills (writing, analysis, and presentation, among others), often as members of a team.
This style of teaching and learning is hardly unknown in higher education. Group work is used widely across disciplines -- and forms of it were dismissed by the authors of the book *Academically Adrift*, who noted that students who studied in groups tended to show smaller learning gains compared to those who studied alone.
But Plopper has devised safeguards for that, which are rooted in how he designed and assesses his courses. After spending the first class of the semester outlining expectations, Plopper breaks the class into six groups of five students, and assigns a group of students the task of giving a presentation on the subject that is to be covered the next week. That is, they are required to teach the subject to their peers the first time they encounter it -- and they must determine what three learning outcomes they expect their fellow students to demonstrate.
Plopper points them to the relevant literature, including journals and a textbook, and the students must sort out what's important and what isn't -- and then grasp the details with enough clarity and complexity that they can convey them to the rest of the class. The final exam will include material that is relevant to the subjects they've covered, but will not be limited to what has been presented in class -- forcing students to read and think widely about the subject independently rather than turn up at class simply waiting to receive information.
Plopper also evaluates the students -- and they evaluate one another (which allows students to call out the slackers on group projects), according to a rubric he shares with them at the start of the semester, which is matched to the various facets of Bloom's Taxonomy. The approach forces Plopper and his students to think not just about the subject matter, but also about the process by which they have come to understand it, he said. He also asks his students to conduct mock grant reviews, so that they gain experience about how ideas are judged and deemed worthy of funding.
While Plopper has been working on, refining and piloting his new method of teaching upper-level courses for the past four years, he has noted encouraging signs -- and risks.
He quantified how often his students demonstrated higher order thinking in their assignments, and saw that it spiked dramatically in the second year of his pilot, but he realized after reanalyzing his grading with a more critical eye that he had fallen prey to crediting his students for sophisticated contributions in class that they weren't truly demonstrating. He adjusted by using more specific, Bloom-related verbs in his assignments. In

the third year of his pilot, the frequency of higher order thinking was lower than in the second year, but still far above where it had started (and it held steady from year three to year four).
Plopper said he also learned to become more explicit in leading his students to think at higher levels. It can be, he said, as simple as asking questions more effectively. For example, Plopper used to ask his students how they might carry out a project. The point of the assignment was to have them critique existing ideas and come up with new, innovative ways to tackle a problem. Instead, he said, his students simply scoped out three existing examples and replicated them.
Now he asks such questions differently, in ways for which there are fewer precedents that compel students to think about how they learn. An example, he said, was asking his students to think about a second edition of their textbook: what would go in it and why?
— Dan Berrett

http://www.insidehighered.com/news/2011/06/09/rensselaer_polytechnic_biology_professor_applies_scientific_method_to_figure_out_if_students_are_really_learning

Thank You for the Scholarship

June 7, 2011
Before scholarship recipients at Barton College receive money for the spring semester, the advancement office attempts something the students' mothers have probably failed at numerous times – getting them to write thank-you notes.
Of course, Barton has a bargaining chip. The scholarship money is withheld until the letters are in the mail. That makes students show up, said Raymond E. Carnley, Barton's director of development.
Colleges and universities often push recipients of endowed scholarships and others who benefit from donations to thank benefactors, but it has rarely been mandatory. Now that budgets are tight and fund-raising is difficult, however, some see compulsory thank-you notes as a tool to help ensure that donors stay connected to the college and see the benefits of their contributions, potentially leading to future donations. Others see the letters that would come from such a requirement as too formulaic to do any good.

Either way, numerous advancement officers said it can't hurt a college to teach some manners to a generation of students unaccustomed to sending thank-you notes.
Advancement officers frame the policy as part fund-raising strategy, part education. Donors who feel connected to the college are more likely to continue to give, these officers say, and they love hearing from students.
"For us it is the first piece of stewardship and starting the next cultivation so people make an additional gift down the road," Carnley said. "Family or whoever is connected to the scholarship can see firsthand the difference their gift is making."
He said the college has long required students to write the notes to benefactors, but only recently made the reception of funds contingent on their doing so. This way the students come to them, instead of the office having to track them down.
Most often the return on such letters comes slowly if it comes at all, advancement officials said, and the notes are only a small component of broader advancement strategies. But occasionally, letters that talk about students' financial position, the benefit of the scholarship, or their experience at college can motivate a person to donate on the spot.
"We've gotten donations after we've sent out thank-you letters," said Saskia DeCaires, director of donor relations for St. John's University, in New York. "People will say, 'I want to increase my gift this year, I was really moved by Tom's letter.' "
Six years ago, DeCaires, along with the financial aid office, instituted a system at St. John's that made students' scholarship funds contingent on a thank-you letter. The university pulls the scholarship money from the student's account if he or she does not write it in a timely manner. Before that, she said, she would solicit

letters from the school's more than 1,000 endowed-scholarship recipients and get about 30. Once students started seeing the money they thought they had received disappear, they showed up in droves.

Barton has a similar system, though all students receive scholarship money for the fall semester and then are asked to go by the advancement office to write the notes. If they are not completed by the spring semester, the student is denied the money for that semester. Once the students complete the letters, the spring scholarship money is restored. Unlike St. John's, which can actually pull the scholarship, Barton would not take a away the scholarship of a student who does not to write a letter, and he or she would still receive it the next fall. But that has never been a problem. "We've never had a student not willing to write the note," Carnley said. "It just takes us reminding them."

At La Sierra University, the scholarship application states that, upon accepting the scholarship, a student will be required to write a thank-you note and attend a luncheon for donors and recipients. If a student does not write the note, the university sends him reminder e-mails. Carol Bradfield, associate vice president for advancement, said the college gives endowed scholarship money to about 140 students a year, and has never had to deny a student a scholarship solely on the grounds of not writing a letter.

There is some debate about whether requiring the students to write the letters does any good. Officials at colleges that don't mandate thank-you notes said the best letters are motivated by actual gratitude, not by a requirement. Mandatory letters can come off looking formulaic.

"We believe that these letters are best when asked for rather than mandated," said Julie Martel, stewardship officer at Hampshire College. "The tone of the letters is honest, celebratory, and personal, which would not be the case if they were demanded rather than volunteered."

Martel said Hampshire encourages scholarship recipients to write letters, and sends out e-mails reminding them, but do not demand that they do so. She said most students who are asked to write letters do so.

Officials at St. Johns, Barton, and La Sierra all said they have seen no drawbacks to the mandatory letters, and recommend the strategy to other colleges and universities. In the best-case scenario, a student who didn't actually think of writing a letter learns a little bit and writes a great letter. The worst that happens, they said, is that a donor gets a formulaic thank-you note that still expresses some gratitude and reminds them of the college.

"I've never had a donor not want a thank-you note because it was required," Bradfield said. "Even if it doesn't mean as much, they're still happy to have them."

In addition to using the letters as a fund-raising tool, administrators often see them as an opportunity to teach students how to write a thank-you note, and to instill a sense of gratitude. Even at many colleges that don't mandate letters, officials have created programs to educate students on writing them.

Some colleges host thank-you-note workshops where they will bring in large groups of students and provide lunch or dinner. Other advancement officers open their offices for one-on-one training. Officials said many students have come into their offices unaware of what should go into such a letter. Most offices suggest that students talk a little bit about themselves, such as what they're studying, their extracurricular activities, and how the scholarship has helped them. Bradfield said La Sierra provides some "simple language" on which students can elaborate.

St. John's sends students to the college's writing center, which DeCaires said serves two missions: the employees there help improve the quality of the students' letters, and the center gets students in the door, making them more likely to return in the future.

Advancement officers hope that students will get a better understanding of philanthropy and possibly donate in the future. "We feel that it's part of the students' education about how to be a good citizen, part of their philanthropic education," Bradfield said.

DeCaires said before she imposed the letter-writing requirement, a lot of students didn't understand that the scholarship money came from an actual person. She said she hopes that, in writing the letters, students come to understand that they, too, could help a student go to college.

— Kevin Kiley

http://www.insidehighered.com/news/2011/06/07/colleges_tie_scholarship_money_to_thank_you_notes

F.D.A. Unveils New Rules About Sunscreen Claims

By GARDINER HARRIS

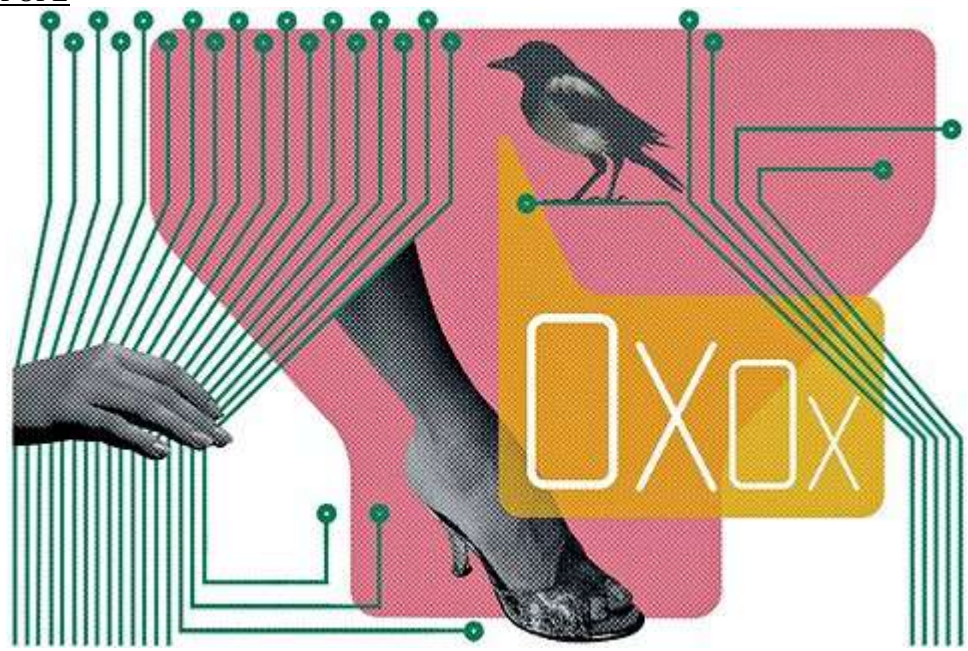
Chip Litherland for The New York Times
Terms like "sunblock," "waterproof" and "sweatproof" will be banned under tougher standards.
WASHINGTON — After 33 years of consideration, the Food and Drug Administration took steps on Tuesday to sort out the confusing world of sunscreens, with new rules that specify which lotions provide the best protection against the sun and ending claims that they are truly waterproof.
The F.D.A. said sunscreens must protect equally against two kinds of the sun's radiation, UVB and UVA, to earn the coveted designation of offering "broad spectrum" protection. UVB rays cause burning; UVA rays cause wrinkling; and both cause cancer.
The rules, which go into effect in a year, will also ban sunscreen manufacturers from claiming their products are waterproof or sweatproof because such claims are false. Instead, they will be allowed to claim in minutes the amount of time in which the product is water resistant, depending upon test results.
And only sunscreens that have a sun protection factor, or SPF, of 15 or higher will be allowed to maintain that they help prevent sunburn and reduce the risks of skin cancer and early skin aging.
The rules have been under consideration since 1978, when "Boogie Oogie Oogie" was a hit on the radio and most beach lotions were intended to encourage tanning, not protect against it. But federal regulators said they had yet to decide whether to end an SPF arms race in which manufacturers are introducing sunscreens with SPF numbers of 70, 80 and 100 even though such lotions offer little more protection than those with an SPF of 50.
Still, dermatologists said they were thrilled.
"Now, we'll be able to tell patients which sunscreens to get," said Dr. Henry W. Lim, chairman of dermatology at Henry Ford Hospital in Detroit and a spokesman for the American Academy of Dermatology.
The rules will transform the $680 million domestic market for sunscreens, which has been growing rapidly because of an aging population and growing worries about skin cancer. And the final regulations are a stark change from a proposal the agency released in 2007, which would have created a star-based system for UVA protection. Under that system, sunscreens would have provided an SPF number for UVB protection and one to four stars for UVA protection.
The agency received more than 3,000 comments on that proposal, with many asserting that allowing products to offer differing levels of protection against UVB and UVA rays would be confusing. So the agency ditched the stars and instead will tell manufacturers that if they wish to label their products as offering "broad spectrum" protection they must make their defense against UVB and UVA radiation proportional.
"We think this is going to be much easier for the consumer to understand," Dr. Janet Woodcock, director of the F.D.A.'s drug center, said in an interview. "All they're going to need to do is pick an SPF number and then make sure that it's broad spectrum."
Any product that fails to offer proportional protection or has an SPF of 2 to 14 must include a warning that the product has not been shown to help prevent skin cancer or early skin aging. The new rules will standardize the testing that manufacturers must conduct for UVA protection.
The agency had proposed allowing manufacturers to use SPF numbers no higher than 50, but that remains only a proposal for which the agency will seek further comment. In particular, the government is asking whether there are special groups of people who would somehow benefit from having a product with an SPF of more than 50.
"Right now, we don't have any data to show that anything above 50 adds any value for anybody," Dr. Woodcock said.
Dr. Warwick L. Morison, a professor of dermatology at Johns Hopkins University and chairman of the photobiology committee for the Skin Cancer Foundation, said he was disappointed that the F.D.A. failed to

ban SPF numbers higher than 50 because such products expose people to more irritating sunscreen ingredients without meaningful added protection.
"It's pointless," Dr. Morison said.
More than two million people in the United States are treated each year for the two most common types of skin cancer, basal cell and squamous cell, and more than 68,000 receive a diagnosis of melanoma, the most deadly form of the disease. Sunscreens have not been shown to prevent the first case of basal cell carcinoma, but they delay reoccurrences of basal cell and have been shown to prevent squamous cell and melanoma.
The F.D.A. announced that it was re-examining the safety of the roughly 17 sunscreen agents approved for use in the United States, although it has no information to suggest that they are not safe. Tuesday's announcement will do nothing to speed the approval of more sunscreen agents. There are roughly 28 such agents approved in Europe and 40 in Japan, and some in the industry complain that the best ingredients have yet to reach American shores.
Some consumer and environmental groups have expressed concern that the ingredients in some sunscreens have been made so microscopic that they could be absorbed through the skin into the body, but Dr. Woodcock said that the F.D.A.'s own
tests had found no cause for such concerns.
The agency is also asking for more information about sunscreen sprays to ensure that consumers get adequate quantities from spray bottles and to explore what happens when those products are inhaled. "You could imagine a child getting a sunscreen sprayed on and turning their face into the blast and breathing it in," Dr. Woodcock said. "It's a question of safety."
The new regulations will do nothing to prevent the most common problem with sunscreens lotions, which is that consumers fail to use enough of them. The rules become effective in one year, although manufacturers with less than $25,000 in annual sales will have two years to comply.
Senator Jack Reed, Democrat of Rhode Island, said the new rules were important. Mr. Reed proposed legislation mandating that the F.D.A. finally adopt the sunscreen proposals it floated in 2007.
"The F.D.A. has been sitting on these proposals for many, many years," Mr. Reed said. "This is a major step, and I'm glad they've done it."

http://www.nytimes.com/2011/06/15/science/15sun.html?_r=1&nl=health&emc=healthupdateema2

Digital Flirting — Easy to Do and Easy to Get Caught

By TARA PARKER-POPE



Stuart Bradford

Representative Anthony Weiner may have taken it to an extreme. But the online flirtations and provocative photos that got him into so much trouble are far from unusual among adults these days, experts say.

Room for Debate

What's Wrong With Adult Sexting?

Experts discuss the ins and outs of adult sexting.

What with Facebook friends, Twitter followers and Skype video chats, it is now all too easy to flirt with strangers and engage in sexual fantasy without (technically) breaking a marriage vow. Digital dalliance has entered the mainstream.

For instance, sexting — sending sexually suggestive text messages or photos, as Mr. Weiner did — is usually thought of as a teenage pastime. But according to a report from the Pew Research Center's Internet and American Life Project based on a representative sample of 2,252 adults, it is far more common among people aged 18 to 29.

Nearly one-third of that group say they have received sexually suggestive or nude photos of someone they know, and 13 percent say they have sent them, the report said. Even among 30-to-49-year-olds, 17 percent say they have received such photos and 5 percent admit sending them. Similar Pew research finds that the comparable figures among adolescents are 15 percent and 4 percent.

"Given the alchemy of sex and lust and love and technology, it's not that surprising that the numbers are where they are," said Amanda Lenhart, a senior research specialist at Pew. "Anecdotally, those of us who know single younger adults know people who do this."

Nancy Baym, a University of Kansas professor of communication studies and author of the new book "Personal Connections in the Digital Age," agreed. "I think we tend to blame teenagers for behaviors that we're quite guilty of ourselves," she said. "Grown-ups are certainly capable of doing really stupid stuff online."

The data reflect the new rules of digital romance, in which flirtatious texts have replaced phone calls, and Web sites like Facebook have replaced high school reunions as a way to reconnect with an old flame.

"We use new technologies in romantic relationships all the time," said Dr. Baym. "When two people meet and they're interested in developing the relationship, they go to text messages really fast as a way to safely negotiate the relationship."

Therapists debate whether the Internet has facilitated more infidelity — after all, men and women have been betraying their vows since marriage began. Still, slight shifts in infidelity rates among young people and women suggest that digital media may be playing a role. Anecdotally, therapists report that electronic contact via Facebook, e-mail and text messages has allowed women in particular to form more intimate relationships.
"There's no question that the Internet has increased the availability of alternative romantic partners, whether it's flirtation, reuniting with old lovers or having texting sexual relationships," Dr. Baym said. "The Internet dramatically expands the scope of potential people that we can meet."
But while online communication may make it easier to cheat, it also leaves a digital trail that makes it more likely you'll be caught.
"I don't think the Internet is increasing transgressions, but it's leaving a trail that is very accessible," said Lois Braverman, president of the Ackerman Institute for the Family. "In the 19th century there were letters; in the '60s and '70s there might be private detective photos or credit card receipts. What's different is that back then a transgression might have been discovered, but it didn't go viral."
Some researchers believe that the widespread availability of pornography via the Internet has also led to an insidious change in attitudes about sex.
One study found that more than a third of Americans had visited an online porn site at least once a month, according to a 2009 report in The Journal of Economic Perspectives. That study analyzed subscriptions to one major provider of adult entertainment, finding a relatively even distribution of subscriptions across the country.
"By all indications it's pretty common," said the author of the paper, Benjamin Edelman, an assistant professor at the Harvard Business School. "Just about anywhere you look, people are subscribing to online adult entertainment. It's something people do in every state, every county."
Tom Hymes, a senior editor at AVN Media Network, a trade publication that follows the adult entertainment industry, said online sexual behavior had been part of the mainstream for years.
"My perspective is that Rep. Weiner was behaving well within certain online norms, as far as what we see happening on a regular basis," he said in an e-mail. "But his huge mistake was thinking he could maintain his anonymity (if indeed he did) when he seemed to be doing everything he could to use his prestige as a congressman in his online flirtations."
Erick Janssen, senior scientist at the Kinsey Institute, said more study was needed to learn how the Internet and digital media are shaping adult behavior and relationships.
"People who engage in behaviors like erotic chats, seduction, exhibition, it's probably indeed very widespread," he said. "That the behaviors are there is hard to dispute. To connect that information with people's relationship status, their values, what their partner might think of it — that sort of thing we don't know a whole lot about."

http://well.blogs.nytimes.com/2011/06/13/digital-flirting-easy-to-do-and-to-get-caught/?nl=health&emc=healthupdateema2

My Therapist Won't Stop Yawning in Session

By John M. Grohol, PsyD
Founder & Editor-in-Chief

Psychotherapy is often described as an art as much as it is a science. The professional relationship between a therapist and their client can be a tricky one. Especially when it comes to bad habits of either the therapist or the client.

One of these bad habits is especially frustrating to clients — a therapist's constant yawns during session. People often read into a yawn far more than what is usually meant — or not meant — by the behavior. Part of the problem is yawning itself — we don't really know why people yawn in the first place. So a person often will assume the worst — "I'm boring him with what I'm talking about." But that's often not the case.

The only thing we know for certain about why humans yawn is that there are a lot of theories. The most popular theory is that we yawn when we're bored or tired. This theory suggests that when we're bored or tired, we tend not to breathe as deeply as we do when we're thinking or engaged with an activity or conversation. Therefore our brains are becoming oxygen-deprived. The theory is that the act of yawning increases oxygen in the blood, which in turn increases oxygen to the brain.

Another set of theories focuses on the impact of yawning behavior on our lungs. One idea is that yawning helps keeps our lungs lubricated with an oil-like substance called *surfactant.* Another lung-focused theory is that yawning stretches our lungs, which is like flexing a muscle. You don't do it very often, but it feels good when you do.

One of the more popular theories is that there is some important social component to yawning. Guggisberg and colleagues (2011) noted, "The only specific effect of yawning that could be demonstrated so far is its contagiousness in humans, some non-human primates, and possibly dogs, whereas all studies investigating physiological consequences of yawns were unable to observe specific yawn-induced effects in the individual of any species." In other words, none of the physiological reasons for yawning really pan out when looked at by researchers.

Yet other researchers suggest there is an evolutionary reason for yawning — one that is no longer serving its evolutionary purpose. Whatever that purpose may have been.

Yawns are, however, socially contagious, and we still don't quite understand why that is.

If you come away from this entry scratching your head about the purpose and meaning of yawns, you're not alone. As you can tell by this cursory look at the research, we are basically still in the dark about why they occur in the first place, what purpose they serve, and why they can be socially contagious.

Psychotherapy and Yawning

This suggests two things about yawning in psychotherapy. The first is that we shouldn't be too hard on a therapist who has a yawning fit while in session. There's no hard evidence yawning is directly related to

boredom or our mind's focus. We all have certainly observed a correlation there, but our self-observation is often unreliable.

Second, although we don't know why people yawn or what purpose yawning serves, a therapist should always be at their professional best when seeing clients. That means coping well with stress, dealing with counter-transference and practice issues as they arise, and maintaining a healthy lifestyle. This latter point means eating right, getting some regular exercise and getting a regular 7 to 8 hours of sleep every night.

If a therapist is doing all of these things, and still gets an attack of "the yawns" while in session, **give them a break** the first few times it happens. But if it seems to happen every time you're in session, consider **changing appointment times**. There are certain times throughout the day that a person can become more tired than usual, such as first thing in the morning, late afternoon (often after 4:00 pm), and right after lunch (early afternoon).

If that doesn't seem to impact the amount they yawn, **consider talking to the therapist directly** about this behavior. While it may seem petty to some, or not really relevant to the reason a person is in therapy, it can negatively impact the therapeutic relationship in subtle (and not so subtle) ways. It's best to bring it out into the open and talk about it.

Yawning is rarely something most of us have much control over. Keep that in mind before you read into your therapist's yawns, and understand that he or she likely doesn't find you boring — they just can't help themselves sometimes.

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http://psychcentral.com/blog/archives/2011/06/03/my-therapist-wont-stop-yawning-in-session/

Lives Cut Short by Depression

By DANIELLE OFRI, M.D.

Jeffrey Conley/Getty Images

There is something about a first friend that is irreplaceable. No matter how disparately your lives travel, the first friend you ever had occupies a special place in your heart. I was lucky that Michael was considerate enough to be born four months before me, waiting next door, ready to join me in elaborate childhood games of hide-and-seek, multilevel couch forts and family camping trips in the Catskills.

Michael was quirky and inquisitive, equally adept at dismantling the innards of a telephone, figuring out how to sing "Hey Jude" backward, and testing the physics of fire escape ladders. We both became vegetarians at sleep-away camp — I because I thought it was cool, Michael because he literally couldn't hurt a fly, protesting the flypaper strips that dangled from the ceilings and carrying spiders out of the cabin to set them free in a thicket of blackberry bushes.

When Michael killed himself during his sophomore year of college, it was a horrible shock. I'd known he'd been depressed, but we'd lost touch, so I hadn't known the extent of it. But it was the fact the he'd shot himself in the face, in his childhood bedroom, while his parents and brother were watching TV downstairs that caused the most intense pain. How could someone who defended flies against the barbarity of flypaper find in himself the capacity for such violence?

As a physician, I know that suicide is the third leading cause of death for Michael's cohort — 15- to 24-year-olds. Every year an estimated million people worldwide take their lives. It's not just one million lives, but millions of families, friends and neighbors left with thorns in their hearts, black holes that may scab over but will never disappear.

Despite all the advances in depression treatment, mors voluntaria, or voluntary death, the Latin term for suicide, remains stubbornly persistent. I had always thought of suicide as what lay at the tarry depths of the funnel of mental illness. Then I came across an essay that offered a slightly different take.

In The Bellevue Literary Review, in an essay called "By My Own Hand," Anita Darcel Taylor writes about her bipolar illness and depression:

I have no grand wish for death. I do not view suicide as a desire to end life or a dramatic way to go down in flames. Rather, it is a tool in my possession — the only one, really — that offers a permanent end to my pain. When I have lost enough of myself to this disease as to become unrecognizable even to me, I will stop. I will go no further. That, I tell myself, is my earned choice.

I have pondered these words many times. The clinician in me wants to insist that with the right tools — therapy, medications, support systems — most depressions can be treated. But the reality is that our tools are often no match for the fury.

Depression screening is now standard. Along with a blood pressure check, all my patients get a depression questionnaire. One question is: "Have you ever had thoughts that you would be better off dead?"

A surprising number of patients say they have, and I find myself in frequent existential conversations about life and death, hunting for pragmatic clues about actual risks for suicide. There are clinical guidelines for assessing risk, but it is an imperfect science.

Two weeks ago, I called one of my patients to reschedule an appointment. A family member answered and told me that my patient had been found dead in his apartment, most likely a suicide. This robust and healthy 54-year-old had screened "negative" for depression at every visit, despite having risk factors: being unemployed, living alone, caring for an ill relative.

I'm not ready to give up hope. I will continue to assiduously treat my patients' depression, but I remain humbled by the fact that even with the best of medical science, we will be successful only in part. And of course there is — as Ms. Taylor points out — the voluntary aspect of mors voluntaria. For some people it might be a rationally used tool. For others, it is a tsunami without possibility of escape. It is precarious, from the outside, to judge.

I can never know how it was for Michael — whether it was a "rational" choice, or simply the relentless blackness of his illness. Despite the decades that have passed since his death, the sadness remains. The graphic nightmares of the gunshot, of his family scrambling to the bedroom, of the unimaginably horrific site that greeted them, have receded. But he comes to me from time to time, and I mourn the child that he was, and the adult that he never had the chance to become. As I watch my own children grow, I have a slip of insight into the exquisiteness of his parents' pain — pain that surely travels with them always.

There is one photograph that comes to mind whenever I remember Michael. It was during a camping trip, and our green Coleman tent looms in the background. Our skinny 7-year-old arms flop over each other's shoulders, and our mouths loll open, yodeling one of the many goofy songs in our repertory.

I want to yodel back into that scene, to those two children, to feel the insouciant, rapturous joy of that moment. If only I could tug out that feeling, wrap it around us like the oversize beach towels we loved, to somehow protect us from the future. I want to warn those children, to warn my own children who are now the same age, and who now go on those same camping trips and sing those same songs.

But I know that I can't. I can only hope. Remember, and hope.

Danielle Ofri is an internist at Bellevue Hospital in New York City and editor in chief of the Bellevue Literary Review. Her most recent book is "Medicine in Translation: Journeys With My Patients."

http://well.blogs.nytimes.com/2011/06/09/lives-cut-short-by-depression/?ref=healthupdate&nl=health&emc=healthupdateemb2

Social Media Join Toolkit for Hunters of Disease

By BRONWYN GARRITY

On a chilly February night in Los Angeles, attendees at the DomainFest Global Conference crushed together in a tent at the Playboy Mansion for cocktails and dancing. Two days later, Nico Zeifang, a 28-year-old Internet entrepreneur from Germany, woke up with chest pains, chills and a soaring fever. Four colleagues shared his symptoms, Mr. Zeifang soon learned.

So he did what any young techie would: He logged on to Facebook and posted a status update. "Domainerflu count," it said. "Who else caught the disease at D.F.G.?"

Within hours, 24 conference attendees from around the world added themselves to Mr. Zeifang's Facebook list; within a week, the number climbed to 80. Many of them "friended" him to get information and to compare notes on their fevers and phlegmy coughs. Almost everyone, it seemed, had a theory about the source of the infection. Many suspected the artificial fog that permeated the tent.

Los Angeles County health authorities and the federal Centers for Disease Control and Prevention stepped in to investigate a few days later. By that time, victims from across the globe already had arrived at their own diagnosis — legionellosis — and had posted their own Wikipedia entry on the outbreak.

Social media — Facebook, Google, Twitter, location-based services like Foursquare and more — are changing the way epidemiologists discover and track the spread of disease. At one time these guardians of public health swooped onto the scene of an outbreak armed with diagnostic kits and a code of silence. Officials spent weeks interviewing victims privately, gathering test results and data, rarely even acknowledging in public that an investigation was under way. The results might not be announced for weeks or months.

Now technology is democratizing the disease-hunting process, upsetting the old equilibrium by connecting people through channels effectively outside government control. While the online chatter can be unproductive or even dangerous — spreading fear along with misinformation about causes and cures — a growing cadre of epidemiologists sees social media as a boon. Future hunts for pathogens may rely as heavily on Twitter streams and odd clusters of search queries as on blood tests and personal histories.

The C.D.C. officer assigned to the Los Angeles case did not show up at Mr. Zeifang's doorstep with a black bag. Instead, she joined his Facebook page, read up on everyone's symptoms, recommended certain diagnostic tests and referred the victims to the agency's online questionnaire. The agency still will not discuss the Los Angeles case or what may have caused the outbreak, the origin of which is unknown, but officials acknowledge the need to modernize.

"We can't turn the clock back," said Dr. Taha Kass-Hout, deputy director for information science at the C.D.C. "Given that the next SARS probably can travel at the speed of an airliner from continent to continent in a matter of hours, it just makes perfect sense to adapt the speed and flexibility of social networking to disease surveillance."

John Brownstein, an assistant professor of pediatrics at Harvard Medical School, is a leader among self-described "computational epidemiologists," who use unconventional data sources to help predict disease outbreaks. "Tapping into people's communications about health events can tell you a lot," Dr. Brownstein said. "Wherever people are having discussions, whether it's Facebook, Twitter, chat rooms or blogs, you can process that information using modern tools and extract key elements."

In 2006, frustrated by the difficulty of getting data from government sources, Dr. Brownstein and Clark Freifeld, a software developer, designed HealthMap, a Web site that tries to pinpoint global outbreaks in real time. HealthMap scours the Web for disease reports from local news articles, witness accounts, blogs, Twitter and official reports from the C.D.C. and World Health Organization, and renders them as little red pins on a map. With a related mobile app, Outbreaks Near Me, users rely on global positioning to help them steer clear of infectious hazards; they also can report new ones from their smartphones. If an amateur report is verified by Dr. Brownstein's team, it appears on the Web site's map as a colored point.

More than 100,000 people have downloaded the mobile app. And while Dr. Brownstein acknowledged the potential for false alarms, he said that this experiment in crowdsourced epidemiology was promising: Erroneous reports submitted by amateurs have been surprisingly few. "We've done a lot of investigations of the data, and the positive reports far outweigh the negative," he said.

In the last few years, scientists have managed to identify regional spikes in seasonal flu a week or more in advance of the C.D.C. by sifting through online search queries and Twitter feeds for flu-related terms. Dr. Brownstein is now collaborating with the C.D.C. and Google to develop methods for online tracking of dengue fever. The first, Google Dengue Trends, started in May.

Skeptics argue that some of the new methods only provide the illusion of better disease tracking. Using last week's C.D.C. flu data to predict this week's caseload is just as effective as parsing millions of Google search terms, said Duncan Watts, principal research scientist at Yahoo and the author of "Everything Is Obvious Once You Know the Answer." Furthermore, use of social media is heavier in big cities and among younger users, which can skew the data.

"Not everyone uses social media, so how representative is it?" said Ruth Lynfield, medical director at the Minnesota Department of Health and the state's epidemiologist.

Dr. Philip Polgreen, an author of a recent study looking at using the Twitter stream to track flu activity, agrees that the utility of using social media to predict flu, at least, is modest. But Dr. Polgreen, director of the emerging infections network of the Infectious Disease Society of America, says the trove of new information can serve as an important adjunct to traditional disease surveillance, especially in the case of new and emerging diseases, or in instances where little or no historical data exists.

A few years ago, Dr. Polgreen saw a patient who had acquired syphilis after an anonymous sexual contact arranged on Craigslist. Syphilis, which has had a resurgence in the last decade, is especially problematic from a public-health perspective because so many cases — a majority, in some communities — are linked to anonymous and untraceable Internet encounters. A national plan to eliminate the disease as a public-health threat has so far been unsuccessful.

Dr. Polgreen and collaborators in his computational epidemiology group at University of Iowa started gathering the anonymous ads to see what they could learn about patterns of sexual behavior in different regions. With more than 131 million posts in their database so far, the group has identified words, like "bareback" (slang for sex without condoms), whose use online indicates neighborhoods with higher syphilis rates. It's not as effective as having the names and phone numbers of those infected, Dr. Polgreen said, but the tool gives health officials a better understanding of sexual behaviors in their areas and provides clues as to how to focus public-health campaigns.

"The way that information moves is very similar to the way disease moves," said Dr. David Fisman, an epidemiologist at the University of Toronto. "We often don't really understand how people move or interact."

http://www.nytimes.com/2011/06/14/health/research/14social.html?nl=health&emc=healthupdateema6

Evolution: Darwin's city

David Sloan Wilson is using the lens of evolution to understand life in the struggling city of Binghamton, New York. Next, he wants to improve it.
Emma Marris


DARWIN'S CITY

David Sloan Wilson is holding a white ceramic dog dish and making the rounds at the Lost Dog Café in Binghamton, New York. "Just like in church!" the biologist jokes, as he collects crumpled dollar bills on this snowy March afternoon. It is Yappy Hour, a fund-raiser for a project to turn an abandoned dirt-bike track into a dog park. The plan is a contender in Wilson's 'Design Your Own Park Competition', a venture that he says is "richly informed" by evolutionary theory — and one of the many community projects that he is running, co-running or up to his neck in. As with most of Wilson's endeavours these days, the motivation is twofold: to improve the quality of life in Binghamton and to study the city as an evolutionary landscape.

Wilson, who works at the State University of New York in Binghamton, has been a prominent figure in evolutionary biology since the 1970s. Much of his research has focused on the long-standing puzzle of altruism — why organisms sometimes do things for others at a cost to themselves. Altruism lowers an individual's chances of passing its own genetic material on to the next generation, yet persists in organisms from slime moulds to humans. Wilson has championed a controversial idea that natural selection occurs at multiple levels: acting not only on genes and individuals, but also on entire groups. Groups with high prosociality — a suite of cooperative behaviours that includes altruism — often outcompete those that have little social cohesion, so natural selection applies to group behaviours just as it does on individual adaptations[1]. Many contend that group-level selection is not needed to explain altruism, but Wilson believes that it is this process that has made humans a profoundly social species, the bees of the primate order.

Wilson originally built the case for multi-level selection on animal studies and hypothetical models. But eight years ago, he decided to come down from the ivory tower and take a closer look at the struggle for existence all around him. A city — with dozens to hundreds of distinct social groups interacting and competing for resources — seemed to Wilson the ultimate expression of humanity's social nature. If prosociality is important in the biological and cultural evolution of human groups, he reasoned, he should be able to observe it at work in Binghamton, a city of about 47,000 people.

The urban laboratory

Differences in prosociality, Wilson thought, should produce measurable outcomes — if not in reproductive success, perhaps in happiness, crime rates, neighbourhood tidiness or even the degree of community feeling expressed in the density of holiday decorations. "I really wanted to see a map of altruism," he says. "I saw it in my mind." And with a frisson of excitement, he realized that his models and experiments offered clues about how to intervene, how to structure real-world groups to favour prosociality. "Now is the implementation phase." Evolutionary theory, Wilson decided, will improve life in Binghamton.

David Sloan Wilson built his career in evolutionary theory but largely ignored the struggle for existence all around him.Malcolm Linton

He now spends his days in church basements, government meeting rooms, street corners and scrubby city parks. He is involved in projects to build playgrounds, install urban gardens, reinvent schools, create neighbourhood associations and document the religious life of the city, among others. Wilson thrives on his hectic schedule, but it is hard to measure his success. Publications are sparse, in part because dealing with communities and local government is time-consuming. And the nitty-gritty practical details often swamp the theory; the people with whom he collaborates sometimes have trouble working out what his projects have to do with evolution.

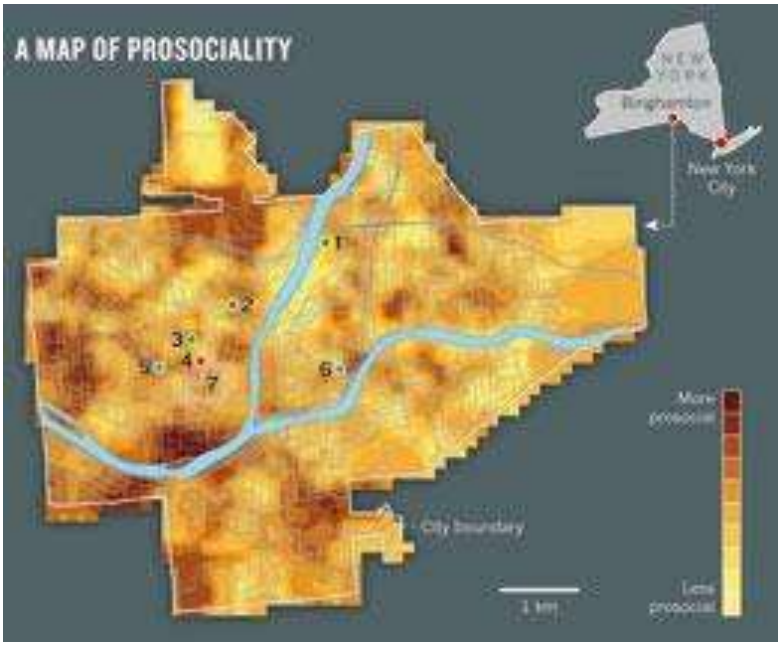
At the Lost Dog, I ask city planner and frequent collaborator Tarik Abdelazim whether he understands why an academic scientist is taking such a proactive interest in the city. He leans against the bar, glass of wine in hand, and addresses Wilson. "I know you talk about 'prosociality', but how that connects to our good friend Darwin, I don't know."

Fellow biologists are also bemused. According to Wilson's former graduate student Dan O'Brien, now a biologist at the Radcliffe Institute for Advanced Study at Harvard University in Cambridge, Massachusetts, many have reacted to Wilson's work with "a mixture of intrigue and distance". That, says O'Brien, "is because he's not doing biology anymore. He's entered into a sort of evolutionary social sciences." Wilson has acquired the language of community organizing and joined, supported and partially funded a slew of improvement schemes, raising the question of whether he is too close to his research. Has David Sloan Wilson fallen in love with his field site?

Binghamton is hard to love. Established in the early nineteenth century, it has long relied on big industry for its identity and prosperity — early on through the Endicott-Johnson Shoe Company and then through IBM, which was founded in the area. But the manufacturers mostly decamped in the 1990s, and since then the city

has taken on an aimless, shabby air. Dollar stores and coin-operated laundries fill the gaps between dilapidated Victorian houses and massive brick-and-stone churches. A Gallup poll in March 2011 listed Binghamton as one of the five US cities least liked by its residents (see go.nature.com/tfdkqi)."It is a town that knows it is badly in need of a revival," says Wilson. Even its motto, 'Restoring the pride', speaks of a city clinging to its past and ashamed of its present.

But as in any city, there is variation: some neighbourhoods are friendlier than others, some are more private and some feel downright dangerous. Wilson started his social experiment by measuring levels of prosociality in each neighbourhood. He and his research group gave surveys to teenagers from the local schools asking how often they helped or were helped by others. The researchers also dropped 200 stamped letters all over the city to see where people would help out a stranger by popping them into the postbox. They even recorded the density of Halloween and Christmas decorations. Wilson's group used some of these data to create maps of the city's prosociality[2]. Neighbourhoods in which people take care of each other appear as peaks, whereas selfishness creates valleys. There isn't a straightforward correlation with any socioeconomic factor, Wilson found. Some of the most cooperative people were from "good, poor neighbourhoods".



So Wilson decided to see whether he could raise up the prosocial valleys by creating conditions in which cooperation becomes a winning strategy — in effect, hacking the process of cultural evolution (see 'A map of prosociality'). He set about this largely by instituting friendly competitions between groups. His first idea was a park-design project, in which neighbourhoods were invited to compete for park-improvement funds by creating the best plan.

But Wilson soon found out that field experiments in real cities can take on lives of their own: different neighbourhoods couldn't get their acts together on the same schedule, so the competition aspect largely disappeared. Instead, he is now working on turning multiple park ideas into reality. The dog park is one. Another is Sunflower Park, the most advanced project to date, but still a sad, mainly empty lot surrounded by a chain-link fence. Children don't spend a lot of time playing here. Undaunted, Wilson is raising funds and laying plans for a relaxing community space flush with trees and amenities. "In a year," he says, "we will serve you a hot dog from the pavilion."

Schooled for success

Wilson starts more projects than one man can usually handle. If there is an idea to paint a mural in a blighted area, Wilson wants in. The design can be a competition. And sure, he'll have time to help. "No project should remain unborn," he says. He then lets time constraints weed his overstuffed garden of initiatives.

Right now, education is winning a sizeable share of Wilson's attention. He and his graduate students are working with school administrators in several locations to see whether they can improve student performance with programmes that reward good behaviour and encourage group cooperation. Treats, mostly donated by teachers, range from snacks and school supplies to odd but coveted items such as toiletries from hotels. Wilson insists that this approach is fundamentally evolutionary, pointing out that in 1981, psychologist B. F. Skinner described how reinforcement and punishment 'select' for desired behaviour[3]. Wilson is tweaking the school environment so that it selects for prosociality, and is hoping that the student culture will evolve accordingly.

The connection is less clear for Miriam Purdy, the principal of Regents Academy, a school for at-risk teenagers at which Wilson has been advising. When I ask how she sees evolution playing into the incentive programmes, Purdy surprises me and Wilson by saying that she doesn't believe in evolution. But that doesn't bother Wilson. It's no matter, he says, if the principles work.

So far, it is hard to tell whether they do. Rick Kauffman, a graduate student who has spent so much time with students and teachers at Regents that he is a de facto staff member, says that no data have been collected on the incentive programmes because the rules have been adjusted weekly. Instead, he and Wilson are comparing the standardized test scores of Regents students with those of a control group of at-risk kids at the more traditional Binghamton High. A higher percentage of Regents students have taken and passed the state tests administered in January, and scientists and administrators alike are looking forward to the results of tests given later in the year.

Wilson with Mary Webster, who is coordinating a 'Design Your Own Park' project.Malcolm Linton

Wilson has also been studying Binghamton's religious institutions through an evolutionary lens. He is an atheist, but sees religion as a potentially positive source of community cohesion and a centre of meaning in people's lives. He has written extensively about religion as an adaptation of groups[4], and has been funded by the Templeton Foundation in West Conshohocken, Pennsylvania, to study its effects. At the moment, he is trying to find out which of Binghamton's 100 or so congregations are the most and least likely to flourish in the current cultural environment.

Wilson's trait of interest is the 'openness' of churches. Traditional protestant denominations, of which Wilson is fond, tend towards openness: details of belief and moral codes are individual, arrived at after prayer and discussion. Newer, conservative churches that adhere strictly to the Bible as a literal text would be considered less open.

Wilson would like to understand from an evolutionary perspective why the membership of open churches in Binghamton is currently declining, but 'closed' churches are booming. Perhaps uncertain times create a fearful and socially isolated populace, interested in firm and clear guidance. Or perhaps closed churches uplift their members or focus on group solidarity and recruitment. When people's economic and educational situations are better they may become attracted to more open churches. And Wilson says it is possible that the open

churches, by allowing congregants to draw their own conclusions in matters of faith, predispose them to losing faith altogether.
Wilson hopes to test these ideas. The first congregation that he is studying is open, liberal and protestant: the Tabernacle United Methodist Church on Main Street. It has 100 regular members, who barely fill the hulking Victorian building. Last year, Wilson and two graduate students met extensively with the church's Strategic Planning Task Force to craft a survey that was given to everyone on the church's rolls in September.
The survey included questions about prosocial behaviour and about religious faith (such as "How often do you experience the following during worship services at this congregation? A sense of God's presence, Inspiration, Boredom, Awe or mystery, Frustration, Spontaneity, A sense of fulfilling my obligation"). The researchers hope to expand the survey to the roughly 100 congregations across the city, and to create maps describing the ecology of religion in Binghamton.
The work has been met with curiosity and befuddlement. Richard Sosis, an evolutionary anthropologist at the University of Connecticut in Storrs, says that the work is wholly appropriate. "Religion is something that is human, generated from the human mind, which has been designed by natural selection." He adds, "People are looking forward to seeing how this all unfolds, and the kind of success he has with it." However, Ron Numbers, a historian of science and religion at the University of Wisconsin–Madison, is "a little ambivalent and confused". Religious groups develop naturally owing to many historical factors, he says. "Going into some evolutionary account about this doesn't add anything to our knowledge."
“People are looking to see how this all unfolds and the kind of success he has with it.”

There is also the possibility that Wilson has become too close to the church. He has held so many community meetings in Tabernacle's basement that he may even have increased the size of the congregation. I asked Wilson whether the effects he has had on the church will contaminate his study. He pauses for a long time before answering, "Not if you are monitoring what you are doing." Wilson is upfront about his affection for the group. "I'd love this church to grow," he says.
One of Wilson's students on the religion project, Ian MacDonald, says that Wilson has "temporarily" allayed his fears about helping religious organizations. But MacDonald is uneasy about what will happen when they try working with closed, dogmatic churches that condemn homosexuality or teach women to obey their husbands' every command. Wilson says that he is, "sympathetic to the 'niche' occupied by 'closed' churches"; he is not there to judge.

Long-term project

The playgrounds, schools and churches are but a few of Wilson's ongoing schemes. Another is the West Side Neighborhood Project, which is surveying residents' attitudes towards groups such as black people and students, before and after the creation of a landlord–tenant association and a student association. And he is even doing some work on the genetic level. In Wilson's office in the city, 15-millilitre conical tubes hold DNA samples from elderly Binghamtonites who have been interviewed for their oral histories.
Each of the 47,000 people in Binghamton generates an infinite number of data points, from genomes to attitudes and habits of prayer. Wilson could spend the rest of his life — and those of several graduate students — studying and influencing lives here. But can he study the town and save it at the same time? Ben Kerr, a biologist at the University of Washington in Seattle, says, "In the sense of providing a deeper understanding, evolutionary biology has something to offer." And he likes that Wilson is doing good in the community, but warns, "One has to exercise caution when moving from descriptive to prescriptive stances."
Among social scientists — and that is arguably what Wilson has become — it is not uncommon to become involved with the communities being studied. Such involvement "might be a social good in itself, but it also helps you understand that community better", says Kathleen Blee, head of sociology at the University of Pittsburgh in Pennsylvania. "The desire to promote a social good may be stronger than leaving your field site untouched," she adds.
Still, does one man have time to do both? Mary Webster, a resident who has been working on a park-design project in her neighbourhood, says that she initially saw Wilson as a professor with all the answers. Now, she says she realizes that he is "flying by the seat of his pants". That "sounds about right", says Wilson and, paraphrasing Einstein, he offers, "If we knew what we were doing, it wouldn't be called research."
It is past eight in the evening at Tranquil, one of the few upscale restaurants in town, where Wilson has invited members of the West Side Neighborhood Project. I quiz Wilson's graduate students about how he

could possibly pay enough attention to them with all the projects on his plate. But they are loath to say anything negative about the man who is buying them dinner. "He's been better recently," says one.

Meanwhile, Wilson disappears to take a call. A letter had been published in Nature that day[5] defending inclusive fitness theory, a framework that seeks to explain the evolution of altruism, and that some evolutionary biologists have called unnecessary. The paper had made ripples in the press, and because Wilson made his name in such theoretical discussions, I assume that he is talking to someone about it. But when he returns, he says that he was on the phone with the religion reporter for the Binghamton Press & Sun-Bulletin, giving the scoop on an agreement to survey more congregations.
What seems like big news in the academic world has faded into the background for Wilson. There is so much to do right where he lives. "When you compare what I am doing here with furiously pounding away on my typewriter about that arcane debate, I think I made the right choice," he says.
Emma Marris writes for Nature from Columbia, Missouri.

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Hadrian's buildings catch the Sun

The Emperor's country estate is aligned to meet the solstices.
Eric Hand

On the solstice, the Sun shines into the Roccabruna building (left), and illuminates the opposite wall (right).M. De Franceschini

Hadrian's villa 30 kilometres east of Rome was a place where the Roman Emperor could relax in marble baths and forget about the burdens of power. But he could never completely lose track of time, says Marina De Franceschini, an Italian archaeologist who believes that some of the villa's buildings are aligned so as to produce sunlight effects for the seasons.

For centuries, scholars have thought that the more than 30 buildings at Hadrian's palatial country estate were oriented more or less randomly. But De Franceschini says that during the summer solstice, blades of light pierce two of the villa's buildings.

In one, the Roccabruna, light from the summer solstice enters through a wedge-shaped slot above the door and illuminates a niche on the opposite side of the interior (see image). And in a temple of the Accademia building, De Franceschini has found that sunlight passes through a series of doors during both the winter and summer solstices.

"The alignments gave me a new key of interpretation," says De Franceschini, who says that the two buildings are connected by an esplanade that was a sacred avenue during the solstices. Based on ancient texts describing religious rituals and study of recovered sculptures, she thinks the light effects were linked to religious ceremonies associated with the Egyptian goddess Isis, who was adopted by the Romans.

De Franceschini, who works with the University of Trento in Italy, will publish a book[1] this summer describing the archaeoastronomical work. She credits two architects, Robert Mangurian and Mary-Ann Ray, for initially noticing the light effect in Roccabruna.

Astronomical alignment

Robert Hannah, a classicist from the University of Otago in New Zealand, says that De Franceschini's ideas are plausible. "They're certainly ripe for further investigation," he says.

Hannah, who is currently seeking to pin down alignments associated with star rises in Greek temples in Cyprus, believes that the Pantheon, a large temple in Rome with a circular window at the top of its dome, also

acts as a giant calendrical sundial[2], with sunlight illuminating key interior surfaces at the equinoxes and on 21 April, the city's birthday.

Few classical buildings have been investigated for astronomical alignment, says Hannah, partly because it is much easier to check for alignments in prehistoric structures such as Stonehenge, which do not have potentially contradictory artefacts.
Jarita Holbrook, a cultural astronomer at the University of Arizona in Tucson, is also not surprised by the solar alignments at Hadrian's villa. They are "a common part of most cultures", she says. But, she adds, it's also easy for buildings to be coincidentally aligned with astronomical features.
De Franceschini plans to spend next week's summer solstice at Hadrian's villa, in the hope of documenting the light effects at Apollo's temple more carefully. Last year's summer solstice was rainy, she says. "I hope that this year we will get better pictures."

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Genome study solves twins' mystery condition

Sequencing ends years of speculation over children's rare disorder.
Erika Check Hayden

Genome sequencing suggested a new approach to treatment for twins Noah and Alexis Beery, shown here with their parents.Life Technologies

Two years ago, 13-year-old Alexis Beery developed a cough and a breathing problem so severe that her parents placed a baby monitor in her room just to make sure she would survive the night. Alexis would often cough so hard and so long that she would throw up, and had to take daily injections of adrenaline just to keep breathing. Yet doctors weren't sure what was wrong.

In a paper published today in Science Translational Medicine[1], researchers led by Richard Gibbs, head of the Baylor College of Medicine Human Genome Sequencing Center in Houston, Texas, describe how they sequenced the genomes of Alexis and her twin brother, Noah, to diagnose the cause of her cough — a discovery that led to a treatment. Today, Alexis is playing soccer and running, and her breathing problem has gone, says Alexis's mother, Retta.

"We honestly didn't know if Alexis was going to make it through this," Retta Beery says. "Sequencing has brought her life back."

At age 5, the Beery twins had already been diagnosed with a genetic disorder called dopa-responsive dystonia, which causes abnormal movements, and had been taking a medication that was apparently successfully treating the condition. When Alexis developed a worsening cough and breathing problem, the twins' neurologists did not think it was related to her dystonia.

The twins' mother Retta Beery, whose husband Joe is the chief information officer at Life Technologies, a biotechnology systems and services company headquartered in Carlsbad, California, pushed for the childrens' genomes to be sequenced to find a definitive answer. The company helped fund the study at Baylor, which used Life's SOLiD sequencing technology to find that the twins carry mutations in a gene called SPR that encodes the enzyme sepiapterin reductase, which was previously linked to some cases of dopa-responsive dystonia.

Sepiapterin reductase enables the synthesis of the neurotransmitters dopamine and serotonin. The twins were already taking a dopamine precursor for their dystonia. So the study suggested that they might benefit from taking a chemical precursor of serotonin, 5-hydroxytryptophan, as well. A month after starting the treatment, Alexis's breathing problem had disappeared. Noah's handwriting has improved and he is also able to concentrate more in school, Retta Beery says.

Chalking up a win

The discovery is a win for genome sequencing in the clinic, which has already been used to guide cancer treatment[2] and to diagnose and treat a handful of rare diseases whose origins are difficult to discern, and so hard to treat[3].

"This study represents a good example of how genetic diagnosis of a rare genetic condition directly impacts treatment," says Joris Veltman of Radboud University Nijmegen Medical Center in the Netherlands.

Indeed, work like this is giving scientists hope that they will soon be able to 'solve' the genetic origins of almost all rare diseases and conditions. This is important because the rarer conditions by definition afflict fewer people than major killers such as heart disease, and so attract little funding for studies. Nor is it possible to organize large clinical trials into conditions that affect so few people (see 'Genomics focus shifts to rare diseases').

There are also relatively few medical doctors who are expert in diagnosing rare diseases, so these conditions are often undiagnosed or misdiagnosed, and available treatments go unused. This is something Retta Beery knows all too well. Her children were incorrectly diagnosed with cerebral palsy at the age of two, and did not receive their correct diagnosis — and first effective treatment — until the age of six, after being subjected to hundreds of tests. And Alexis endured six years of inconclusive tests before sequencing pinpointed the cause of her breathing problem, Retta Beery says.

The work published today suggests that sequencing could shorten diagnostic odysseys like these, because it tests for all possible genomic mutations at once, thereby guiding the way towards treatments aimed at particular biochemical pathways, and does not need to be ordered by specialists in rare diseases. Gibbs predicts that 90% of disorders caused by single gene defects will be solved in the next three to four years.

"The availability of unbiased whole genome or exome sequencing will make an enormous impact on our opportunity to diagnose and treat patients with rare disease," agrees Veltman, whose centre is now offering exome sequencing — sequencing just the coding regions of genes, rather than the whole genome — to patients with disorders including intellectual disability, blindness, deafness, movement disorders and hereditary forms of cancer.

The big question is when whole-genome sequencing will be inexpensive enough for routine clinical use. Gibbs estimates that the study released today cost about US$100,000, including $30,000 to sequence each twin's genome, and took two months. But some companies are offering sequences for as little as $5,000 to $7,500. Researchers think that when sequencing drops to $1,000 per patient, it will become more widespread. Beery says that for other families who need it, that day cannot come soon enough.

"It's ridiculous to think of the amount of time and money that we and our insurance company have spent, and the amount of suffering our kids went through, when they could have had their blood drawn once and got the answer," Beery says.

Follow Erika on Twitter at @Erika_Check

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Misconceptions about forest-dwellers overturned

Study rejects claims that poor residents cause most deforestation.
Natasha Gilbert

For many, such as these Ugandan Pygmies in Semliki National Park, Bundibugyo, forests are the main source of food.REUTERS/J. Akena

Forests are vital to the livelihoods of millions of people in developing countries, providing on average more than one-fifth of their annual income, according to data presented today at a meeting in London.

The study provides much-needed solid evidence for the importance of forests to the world's rural poor. It also overturns some existing assumptions, showing, for example, that forests provide vital income to whole communities, not just the poorest, and that richer households are most likely to contribute to deforestation.

Income from forests has been largely "undervalued", particularly in assessments of poverty and income such as the World Bank's Living Standard Measurement Survey, says Arild Angelsen, an environmental economist at the Norwegian University of Life Sciences in Aas and a lead author of the study by the Center for International Forestry Research (CIFOR) based in Bogor, Indonesia. He presented the findings at the Royal Society, the United Kingdom's national academy of science.

Part of the problem, adds Frances Seymour, CIFOR's director-general, has been that most previous studies looked at anecdotal evidence from single sites. The lack of solid evidence has led to questions over claims that forests are important to the livelihoods of poor people.

Robust data

Angelsen's team collected data from 8,000 households across 24 countries, including China, Zambia and Indonesia, four times a year over a period of six years. This makes the study the largest and most robust so far on the links between forests and poverty.

The researchers found that firewood accounts for around a fifth of the income that comes from forests, with timber coming in second at 10%.

One unexpected discovery was that the poorest forest-dwelling people do not cause the bulk of deforestation. In fact, the richest 20% of households at each study site caused 30% more deforestation than the poorest 20%.

The work also showed that although the poorest households are reliant on forests for their daily needs, they also look elsewhere — for example, travelling to urban areas — when drastic action is needed to feed themselves or urgently acquire income. "I was surprised that poor people did not rely on forests as a safety net," says Angelsen.

Not just carbon

Researchers hope that the data will inform policies that aim to conserve forests at the same time as reducing poverty. Mike Speirs, an environment and climate-change adviser to the Danish government who was present at the Royal Society meeting, welcomed the study's contribution to ensuring that forests are not seen by governments and the international community as "just stocks of carbon".
But Bill Adams, a conservation and development scientist at the University of Cambridge, UK, says that despite the new data, it will be "difficult to achieve win–win outcomes for forest conservation and poverty reduction".
Attempts to protect forests can be bad news for the poor, particularly if locals are evicted and banned from protected areas, he told the meeting. Moreover, projects attempting to address both conservation and poverty reduction are often expensive, complex to plan and slow to deliver results — and their success is difficult to predict.

Adams argues that forest-conservation and poverty-reduction initiatives, including the United Nations' extended Reducing Emissions from Deforestation and Forest Degradation (REDD+) scheme, will work only if they are implemented from the bottom up, with locals involved in decision-making and their access and land rights recognized. "But this does not occur in most places," he says.
The CIFOR study does show examples of how forest conservation and livelihoods can be integrated, but Adams cautions that it suggests "no overarching strategy" for conserving biodiversity while reducing poverty.

http://www.nature.com/news/2011/110615/full/news.2011.371.html

Mouse library set to be knockout

Global effort to disable every mouse gene nears completion.
Elie Dolgin

Mutant mice generated from embryonic stem-cell lines should further understanding of human disease.WELLCOME LIBRARY, LONDON

Investigators are on the home stretch of the largest international biological research initiative since the Human Genome Project. Launched in 2006 in North America and Europe, the effort aims to disable each of the 20,000-odd genes in the mouse genome and make the resulting cell lines available to the scientific community.

After five years and more than US$100 million, the pace is picking up. "In the next three years or so we assume we will have it completed," says Wolfgang Wurst, director of the Institute of Developmental Genetics at the Helmholtz Centre Munich in Germany and one of the leaders of the effort's European contribution.

"This resource will be of enormous benefit, not just to the mouse genetic community but to every scientist, every company looking at mammalian physiology, and of course everyone who wants to design better drugs and better health care," says Steve Brown, director of the Mammalian Genetics Unit at MRC Harwell, UK. "It is one of the most significant biological resources in the past century of science, and I don't think I'm overstating the case here."

Previously, researchers typically spent years engineering mice to lack specific genes so that they could model human diseases involving those genes. This process was slow, laborious and piecemeal. And even after all that effort, there was often no easy way to share the animals with other researchers. So the International Knockout Mouse Consortium (IKMC) set out to create a library of mouse embryonic stem-cell lines representing every possible gene knockout, and then to distribute the cells to researchers for further study.

A new technology — pioneered by Bill Skarnes and Allan Bradley at the Wellcome Trust Sanger Institute in Hinxton, UK, and described today in Nature (W. C. Skarnes et al. Nature **474,** 337–342; 2011) — helped make that possible. Using a high-throughput gene-targeting pipeline that allowed them to precisely engineer hundreds of genes every month, the Sanger team, in collaboration with colleagues in Germany and the United States, has so far inactivated more than 9,000 genes in mouse embryonic stem cells. It is on track to knock out 7,500 more in the next few years. "We're really hitting our peak production now," Skarnes says.

“It is one of the most significant biological resources in the past century of science.”

Each bespoke knockout in the Sanger group's library contains an added 'conditional allele'. This allows scientists to disrupt gene function in a living mouse at any body site and at any point in the animal's development by the timely addition of enzymes that recognize the inserted allele. By this means, the effects of the missing gene do not kill the mouse before the researchers have a chance to study it.

"It is truly a feat of genius," says Geoff Hicks, a geneticist at the University of Manitoba in Winnipeg who leads the Canadian contribution to the IKMC. "This paper really pushed the technology in an extremely innovative way and met a challenge that seemed unattainable."

Various groups in the international effort are using other, non-conditional techniques to inactivate thousands more genes. Researchers in Texas, Canada and Germany have mutated close to 12,000 genes using an untargeted approach called gene trapping, and Regeneron Pharmaceuticals, a company based in Tarrytown, New York, has specifically targeted around 3,500 genes using a technology that works well in smaller genes

but results in mice that are less flexible for research than conditional knockouts. "The approaches are complementary," says Aris Economides, Regeneron's senior director of genome engineering technologies. "This is going to play out well for the end user."
To date, nearly 17,000 different genes have been knocked out, leaving only around 3,000 more to go. The Sanger team, however, hopes to replace most of the genes hit by gene trapping with conditionally targeted knockouts, because targeting allows individual genes to be manipulated with greater precision.

Already, mutant mice have been generated from almost 1,000 of the embryonic stem-cell lines obtained, and the IKMC repositories in the United States, Canada and Europe receive hundreds of new orders every month. The next challenge is to study the function of each missing gene. To this end, the US National Institutes of Health last year committed $110 million over the next five years to characterize around 2,500 of the IKMC's mutant mice through the International Mouse Phenotyping Consortium, with plans for another $110 million to define 5,000 more if the first phase is successful.
"Knocking out the mice is simple relative to the huge task of finding out what all those genes do," says Richard Finnell, a geneticist at the Texas A&M Health Science Center in Houston.

http://www.nature.com/news/2011/110615/full/474262a.html

Voyager at the edge

Spacecraft finds unexpected calm at the boundary of Sun's bubble.
Geoff Brumfiel

The Voyager 1 spacecraft, and its partner, Voyager 2, are approaching the edge of the Sun's protective bubble.
NASA/JPL-Caltech

Seventeen and a half billion kilometres from Earth, mankind's most distant probe seems to be on the edge of interstellar space.

The Voyager 1 spacecraft is at the limit of the 'heliosheath', where particles streaming from the Sun clash with the gases of the galaxy. Contrary to scientists' expectation of a sharp, violent edge, the boundary seems to be a tepid place, where the solar wind mingles with extrasolar particles.

"We're in this mixed-up region where the Sun still has some influence," says Stamatios Krimigis, a physicist at the Applied Physics Laboratory of Johns Hopkins University in Laurel, Maryland. "It's certainly not what we thought."

“We may have crossed into interstellar space and don't know it.”
Stamatios Krimigis
Johns Hopkins University in Laurel, Maryland

The new findings, reported by Krimigis and his colleagues this week in Nature, are the latest of many during the spacecraft's long journey[1]. Launched in 1977, Voyager 1 photographed active volcanoes on the moon Io on its way past Jupiter in 1979. The following year, it confirmed the existence of three new moons orbiting Saturn. In one of its final photographs, transmitted in 1990, Earth appears as a grainy speck bathed in the rainbow rays of the Sun.

Crossing the unknown

Since then, NASA scientists have shut down six of its ten instruments, and it is so far away that transmissions now take more than 16 hours to reach Earth. But Voyager's work continues. It is now travelling out of the heliosphere, the bubble of space filled by the Sun's wind. In late 2004, Voyager 1 crossed the 'termination shock', the boundary beyond which the solar wind's influence begins to wane. And this year researchers were expecting it to meet another boundary — one at which the solar wind sharply reverses direction, signalling the beginning of interstellar space.

Instead, Krimigis says, measurements of low-energy charged particles show that the solar wind has gradually slowed to zero and is mingling with interstellar gases. Theories failed to predict this mixed-up environment,

and Krimigis says it may even be possible that this is, in fact, what interstellar space looks like. "We may have crossed and don't know it, because nobody has a model that describes what we're seeing," he says.

The blowing of far-flung interstellar gases may seem inconsequential to those of us closer to the Sun, but the details do matter, says Voyager's chief scientist Ed Stone at the California Institute of Technology in Pasadena. The Sun is currently flying through debris from several nearby supernovae. Streams of particles and the magnetic fields produced by our star are shielding us from the some of the interstellar radiation from the blasts, he says. "The size of this bubble is important."
Voyager should be able to provide more answers in the coming years. The spacecraft's plutonium power plant will allow it to operate smoothly until at least 2020, and "we will continue to be taking data", says Krimigis. Even after its signal fades, the spacecraft's journey will continue; it should pass the constellation Camelopardalis in around 40,000 years.

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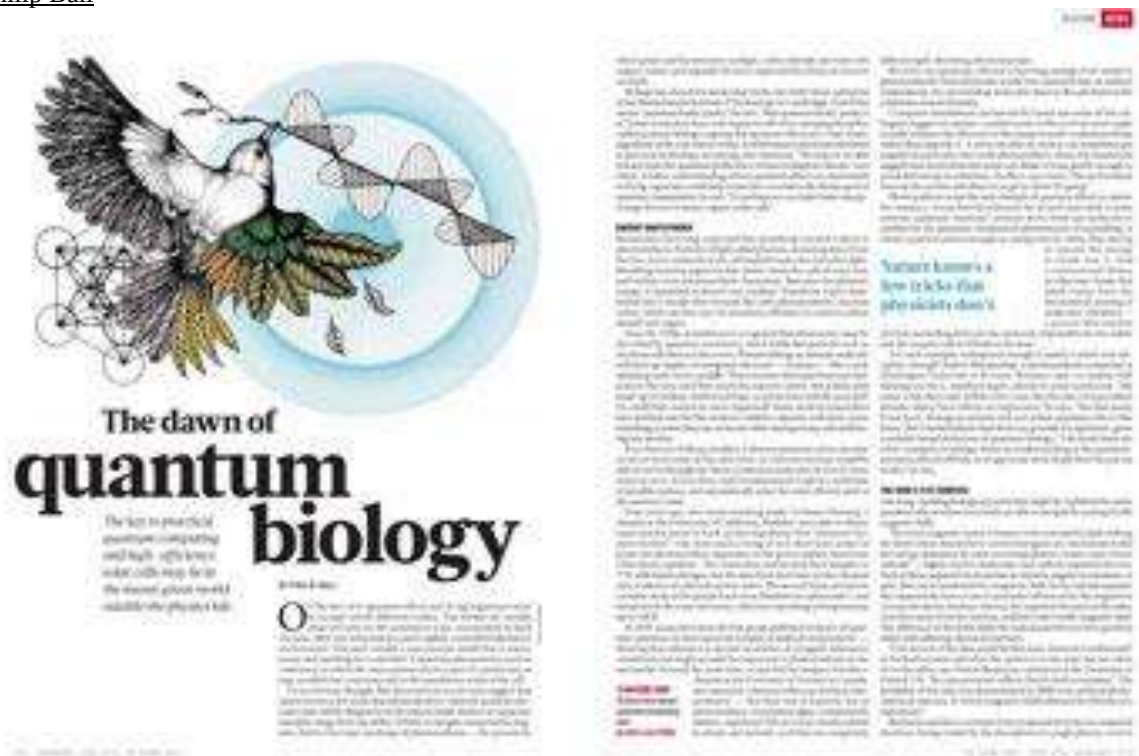
Physics of life: The dawn of quantum biology

The key to practical quantum computing and high-efficiency solar cells may lie in the messy green world outside the physics lab.

Philip Ball



On the face of it, quantum effects and living organisms seem to occupy utterly different realms. The former are usually observed only on the nanometre scale, surrounded by hard vacuum, ultra-low temperatures and a tightly controlled laboratory environment. The latter inhabit a macroscopic world that is warm, messy and anything but controlled. A quantum phenomenon such as 'coherence', in which the wave patterns of every part of a system stay in step, wouldn't last a microsecond in the tumultuous realm of the cell.

Or so everyone thought. But discoveries in recent years suggest that nature knows a few tricks that physicists don't: coherent quantum processes may well be ubiquitous in the natural world. Known or suspected examples range from the ability of birds to navigate using Earth's magnetic field to the inner workings of photosynthesis — the process by which plants and bacteria turn sunlight, carbon dioxide and water into organic matter, and arguably the most important biochemical reaction on Earth.

Biology has a knack for using what works, says Seth Lloyd, a physicist at the Massachusetts Institute of Technology in Cambridge. And if that means "quantum hanky-panky", he says, "then quantum hanky-panky it is". Some researchers have even begun to talk of an emerging discipline called quantum biology, arguing that quantum effects are a vital, if rare, ingredient of the way nature works. And laboratory physicists interested in practical technology are paying close attention. "We hope to be able to learn from the quantum proficiency of these biological systems," says Lloyd. A better understanding of how quantum effects are maintained in living organisms could help researchers to achieve the elusive goal of quantum computation, he says. "Or perhaps we can make better energy-storage devices or better organic solar cells."

Energy routefinder

Researchers have long suspected that something unusual is afoot in photosynthesis. Particles of light called photons, streaming down from the Sun, arrive randomly at the chlorophyll molecules and other light-absorbing 'antenna' pigments that cluster inside the cells of every leaf, and within every photosynthetic bacterium. But once the photons' energy is deposited, it doesn't stay random. Somehow, it gets channelled into

a steady flow towards the cell's photosynthetic reaction centre, which can then use it at maximum efficiency to convert carbon dioxide into sugars.
Since the 1930s, scientists have recognized that this journey must be described by quantum mechanics, which holds that particles such as electrons will often act like waves. Photons hitting an antenna molecule will kick up ripples of energized electrons — excitons — like a rock splashing water from a puddle. These excitons then pass from one molecule to the next until they reach the reaction centre. But is their path made up of random, undirected hops, as researchers initially assumed? Or could their motion be more organized? Some modern researchers have pointed out that the excitons could be coherent, with their waves extending to more than one molecule while staying in step and reinforcing one another.
"Nature knows a few tricks that physicists don't."

If so, there is a striking corollary. Coherent quantum waves can exist in two or more states at the same time, so coherent excitons would be able to move through the forest of antenna molecules by two or more routes at once. In fact, they could simultaneously explore a multitude of possible options, and automatically select the most efficient path to the reaction centre.
Four years ago, two teams working under Graham Fleming, a chemist at the University of California, Berkeley, were able to obtain experimental proof to back up this hypothesis (See 'Quantum fact meets fiction'). One team used a string of very short laser pulses to probe the photosynthetic apparatus of the green sulphur bacterium Chlorobium tepidium[1]. The researchers had to chill their samples to 77 K with liquid nitrogen, but the data from their laser probes showed clear evidence of coherent exciton states. The second team carried out a similar study of the purple bacterium Rhodobacter sphaeroides[2], and found much the same electronic coherence operating at temperatures up to 180 K.
In 2010, researchers from the first group published evidence of quantum coherence in their bacterial complex at ambient temperatures[3] — showing that coherence is not just an artefact of cryogenic laboratory conditions, but might actually be important to photosynthesis in the real world. Around the same time, a team led by Gregory Scholes, a chemist at the University of Toronto in Canada, also reported coherence effects at ambient temperatures[4] — this time not in bacteria, but in photosynthetic cryptophyte algae, evolutionarily distinct organisms that are more closely related to plants and animals, and that use completely different light-absorbing chemical groups.
But how can quantum coherence last long enough to be useful in photosynthesis? Most physicists would have assumed that, at ambient temperatures, the surrounding molecular chaos in the cell destroys the coherence almost instantly.
Computer simulations carried out by Lloyd and some of his colleagues suggest an answer: random noise in the environment might actually enhance the efficiency of the energy transfer in photosynthesis rather than degrade it[5]. It turns out that an exciton can sometimes get trapped on particular sites in the photosynthetic chain, but simulations suggest that environmental noise can shake it loose gently enough to avoid destroying its coherence. In effect, says Lloyd, "the environment frees up the exciton and allows it to get to where it's going".
Photosynthesis is not the only example of quantum effects in nature. For instance, researchers have known for several years that in some enzyme-catalysed reactions[6], protons move from one molecule to another by the quantum-mechanical phenomenon of tunnelling, in which a particle passes through an energy barrier rather than having to muster the energy to climb over it. And a controversial theory of olfaction claims that smell comes from the biochemical sensing of molecular vibrations — a process that involves electron tunnelling between the molecule responsible for the odour and the receptor where it binds in the nose[7].
Are such examples widespread enough to justify a whole new discipline, though? Robert Blankenship, a photosynthesis researcher at Washington University in St Louis, Missouri, and a co-author with Fleming on the C. tepidium paper, admits to some scepticism. "My sense is that there may well be a few cases, like the ones we know about already, where these effects are important," he says, "but that many, if not most, biological systems will not utilize quantum effects like these." But Scholes believes that there are grounds for optimism, given a suitably broad definition of quantum biology. "I do think there are other examples in biology where an understanding at the quantum-mechanical level will help us to appreciate more deeply how the process works," he says.

The bird's-eye compass

One long-standing biological puzzle that might be explained by exotic quantum effects is how some birds are able to navigate by sensing Earth's magnetic field.

The avian magnetic sensor is known to be activated by light striking the bird's retina. Researchers' current best guess at a mechanism is that the energy deposited by each incoming photon creates a pair of free radicals[8] — highly reactive molecules, each with an unpaired electron. Each of these unpaired electrons has an intrinsic angular momentum, or spin, that can be reoriented by a magnetic field. As the radicals separate, the unpaired electron on one is primarily influenced by the magnetism of a nearby atomic nucleus, whereas the unpaired electron on the other is further away from the nucleus, and feels only Earth's magnetic field. The difference in the fields shifts the radical pair between two quantum states with differing chemical reactivity.

"One version of the idea would be that some chemical is synthesized" in the bird's retinal cells when the system is in one state, but not when it's in the other, says Simon Benjamin, a physicist at the University of Oxford, UK. "Its concentration reflects Earth's field orientation." The feasibility of this idea was demonstrated in 2008 in an artificial photochemical reaction, in which magnetic fields affected the lifetime of a radical pair[9].

"This might just give us a few clues in the quest to create quantum technology."

Benjamin and his co-workers have proposed that the two unpaired electrons, being created by the absorption of a single photon, exist in a state of quantum entanglement: a form of coherence in which the orientation of one spin remains correlated with that of the other, no matter how far apart the radicals move. Entanglement is usually quite delicate at ambient temperatures, but the researchers calculate that it is maintained in the avian compass for at least tens of microseconds — much longer than is currently possible in any artificial molecular system[10].

This quantum-assisted magnetic sensing could be widespread. Not only birds, but also some insects and even plants show physiological responses to magnetic fields — for example, the growth-inhibiting influence of blue light on the flowering plant Arabidopsis thaliana is moderated by magnetic fields in a way that may also use the radical-pair mechanism[11]. But for clinching proof that it works this way, says Benjamin, "we need to understand the basic molecules involved, and then study them in the lab".

Selected benefits

Quantum coherence in photosynthesis seems to be beneficial to the organisms using it. But did their ability to exploit quantum effects evolve through natural selection? Or is quantum coherence just an accidental side effect of the way certain molecules are structured? "There is a lot of speculation about the evolutionary question, and a lot of misunderstanding," says Scholes, who is far from sure about the answer. "We cannot tell if this effect in photosynthesis is selected for, nor if there is the option not to use coherence to move the electronic energy. There are no data available at all even to address the question."

He points out that it isn't obvious why selection would favour coherence. "Almost all photosynthetic organisms spend most of the day trying to moderate light-harvesting. It is rare to be light-limited. So why would there be evolutionary pressure to tweak light-harvesting efficiency?" Fleming agrees: he suspects that quantum coherence is not adaptive, but is simply "a by-product of the dense packing of chromophores required to optimize solar absorption". Scholes hopes to investigate the issue by comparing antenna proteins isolated from species of cryptophyte algae that evolved at different times.

But even if quantum coherence in biological systems is a chance effect, adds Fleming, its consequences are extraordinary, making systems insensitive to disorder in the distribution of energy. What is more, he says, it "enables 'rectifier-like' one-way energy transfer, produces the fastest [energy-transfer] rate, is temperature-insensitive and probably a few other things I haven't thought of".

These effects, in turn, suggest practical uses. Perhaps most obviously, says Scholes, a better understanding of how biological systems achieve quantum coherence in ambient conditions will "change the way we think about design of light-harvesting structures". This could allow scientists to build technology such as solar cells with improved energy-conversion efficiencies. Seth Lloyd considers this "a reasonable expectation", and is particularly hopeful that his discovery of the positive role of environmental noise will be useful for engineering photonic systems using materials such as quantum dots (nanoscale crystals) or highly branched polymers studded with light-absorbing chemical groups, which can serve as artificial antenna arrays.

Another area of potential application is in quantum computing. The long-standing goal of the physicists and engineers working in this area is to manipulate data encoded in quantum bits (qubits) of information, such as the spin-up and spin-down states of an electron or of an atomic nucleus. Qubits can exist in both states at once, thus permitting the simultaneous exploration of all possible answers to the computation that they encode. In principle, this would give quantum computers the power to find the best solution far more quickly than today's computers can — but only if the qubits can maintain their coherence, without the noise of the surrounding environment, such as the jostling of neighbouring atoms, destroying the synchrony of the waves. But biology has somehow solved that challenge: in effect, quantum coherence allows a photosystem to perform a 'best-path' quantum computation. Benjamin, whose main interest is in designing materials systems for quantum computation and information technology, sees the ambient-temperature avian compass as a potential guide. "If we can figure out how the bird's compass protects itself from decoherence, this might just give us a few clues in the quest to create quantum technologies," he says. Learning from nature is an idea as old as mythology — but until now, no one has imagined that the natural world has anything to teach us about the quantum world.
Philip Ball is a writer based in London.

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Twisted structure preserved dinosaur proteins

Collagen coils might have kept Tyrannosaurus molecules safe from harm for millions of years.
Ed Yong

Researchers are divided on whether Tyrannosaurus rex proteins have survived to the present day.L. Psihoyos/Corbis

Scientists have discovered how fragments of the protein collagen might have survived in fossilized dinosaur bones. The intertwining, rope-like structure of the molecule, a major component of bone, could have shielded parts of the protein from enzymes and the elements for tens of millions of years, they say.

The results, which are published in PLoS ONE[1], support the contentious claim that dinosaur proteins have been recovered and sequenced.

Collagen molecules consist of three long protein subunits that coil around each other in a triple helix. Five of these helices wind together to make up a microfibril, and thousands of microfibrils gather to form a fibril.

"It's like a massive, multi-stranded rope," says James San Antonio, lead author of the paper and a biochemist at Orthovita, a medical-implant manufacturer in Malvern, Philadelphia.

San Antonio and his colleagues analysed 11 fragments of collagen recovered from the fossilized bones of a 68-million-year-old Tyrannosaurus rex and an 80-million-year-old Brachylophosaurus canadensis.

Mary Schweitzer, a palaeontologist at North Carolina State University in Raleigh, and her colleagues have previously claimed to have found soft tissues and collagen in these remains[2,3]. Other scientists think that the recovered proteins are modern contaminants (see 'Origin of T. rex protein questioned')

Protein puzzle

San Antonio's team compared the recovered collagen fragments with models of human and rat collagen, and found that all 11 pieces came from the innermost parts of the microfibrils. Some originated in the same location in both dinosaurs. The researchers say that sites deep inside the collagen fibre would have been shielded from degrading enzymes and the environment.

The recovered collagen also contains very few acidic amino acids, constituents of protein that are particularly vulnerable to degradation by enzymes and water. Joseph Orgel, a co-author of the report who studies collagen at the Illinois Institute of Technology in Chicago, adds that collagen fibres are often buried within bone, which could preserve them "far beyond our current best estimates".

The study is "interesting and plausible, but speculative", says Marshall Bern, a computer scientist at Palo Alto Research Center in California, who has also analysed dinosaur-protein data. "It's hard to extrapolate too far from the little bit of sequence that has been found," he says.

Others are more sceptical. Stephen Salzberg, a geneticist at the University of Maryland in College Park, has already posted a critical comment about the paper at PLoS ONE, saying that the peptides that the team analysed "are contaminants from modern species".

Bone of contention

Salzberg says that the oldest verified proteins are bacterial molecules hundreds of thousands of years old found in ice cores. The dinosaur bones are many times older than that, and were found in temperate Idaho. Theoretical predictions and lab experiments suggest that proteins cannot survive for more than a few million years.
But Schweitzer, who also contributed to the latest study, counters that if the collagen fragments were contaminants, they should have come from random parts of the structure. Instead, they all came from the most protected parts of the microfibril, supporting the idea that they are genuine dinosaur relics.

Schweitzer notes that her claims have been supported by two labs besides her own[3]. Furthermore, no collagen was found in sediments around the fossils, as would have been expected if the molecules were contaminants; and the team got positive results when testing the samples using antibodies that stick to collagen and other bone proteins.
As well as telling us how dinosaurs lived, Schweitzer believes that work on their proteins could inform the design of more effective and resilient collagen for use in prostheses or medical implants.
"The first and largest hurdle has been to convince people that this stuff is real," she says. "This paper is a step in that direction."

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Studies spy on a river's rage
Investigation into this year's Mississippi floods could shape coastal restoration plans.
Gwyneth Dickey Zakaib

Devastating floods on the Mississippi this year have given researchers a rare opportunity to study how the river deposits the muds that build coastal marshes.AP Photo/J. Roberson

Venice, Louisiana

The research vessel Acadiana rolls with the waves in the Gulf of Mexico, 10 kilometres off the coast of Louisiana. Scientists and crew members scan the murky waters. Suddenly, triggered by an acoustic signal, a cluster of bright-yellow buoys comes bobbing up to the surface.

The captain steers towards the floats, which carry a radar instrument that has spent the past 20 hours on the sea floor. The device has been measuring the velocity of the water pouring from the Mississippi River, where floodwaters have risen to levels not seen in decades. "There's a raging torrent coming out," says Carol Lutken, associate director for research programmes at the Mississippi Mineral Resources Institute in Oxford, Mississippi, which helped to organize the expedition. "It's like a fire hose."

The survey earlier this month is part of an ongoing interdisciplinary effort by researchers to learn how the flooding river discharges water and where it deposits its sediment load. Those muds could have a role in restoring the diminishing marshes along the Louisiana coast. The flood "is a catastrophic event, but it's a rare opportunity to understand the physics of the Mississippi delta," says Federico Falcini, a physical oceanographer at the University of Pennsylvania in Philadelphia, and one of the project coordinators.

Heavy rains across the Mississippi watershed in April led to devastating floods far up the waterway, forcing entire communities to evacuate. On 14 May, as the high water moved into Louisiana, the US Army Corps of Engineers began opening floodgates in the Morganza Spillway, some 450 kilometres upstream of the gulf. Their purpose was to divert water into the Atchafalaya River, which follows its own course to the sea. The move spared developed areas downstream — including the cities of Baton Rouge and New Orleans. It also set up the ideal conditions for a direct comparison of river dynamics and sediment deposition in two very different waterways.

"If we don't do something to save the landscape, the entire coast will be gone."

The Mississippi is hemmed in by a system of embankments and kept open for shipping by constant dredging. It reaches the sea in a few long, narrow channels, flanked by diminishing marshlands. By contrast, the less-controlled Atchafalaya emits a diffuse plume, which exits through networks of bifurcating channels and feeds a growing marsh called the Wax Lake Delta. Using satellites to compare the discharge of the two rivers, and the Acadiana to very the satellite measurements of the Mississippi, Falcini and his colleagues will try to determine the conditions that build healthy wetlands. "The theory is, if you can tune the channel geometry on

the Mississippi River Delta, maybe it will do something like what the Wax Lake is doing: spreading and making deposition just in front of the river," says Falcini.
He and Douglas Jerolmack, a geophysicist at the University of Pennsylvania, hope to validate a model in which the faster water is moving as it exits a river, the farther into the sea it will carry sediment (F. Falcini and D. J. Jerolmack J. Geophys. Res. doi:10.1029/2010JF001802; 2010). This relationship would be especially important during floods, which carry unusually heavy loads of sediment that contribute to marsh-building along the coast. "We're going to learn a whole lot that we'll use to inform and expand our model," says Jerolmack.

Falcini's team is one of a few groups studying the floods for clues to restoring the wetlands, which buffer the coast from hurricanes, floods and storm surges by absorbing water and wave power. The US Geological Survey says that nearly 43 square kilometres of Lousiana's coastal marshes have been disappearing each year since 1985, owing to sea-level rise, subsidence and sediment deficit. As a result, the open waters of the gulf are creeping closer to New Orleans, increasing its vulnerability to hurricanes. "We're conscious that if we don't do something to save the landscape, the entire coast will be gone," says Steve Mathies, executive director of the Louisiana Office of Coastal Protection and Restoration in Baton Rouge, which is developing a plan for coastal restoration.

Some scientists say that the best way to save the coast is to divert more of the Mississippi's floodwaters upstream to increase the amount of sediment reaching the marshes, but they don't know how to ensure that the sediment will be captured where it is needed. Falcini's model suggests that one way would be to widen channels that feed into the ocean, so that the water slows down and sediments settle out.
The researchers are using satellites to track sediment concentration at the water's surface, among other variables. They will validate those data using velocity measurements and samples gathered by the Acadiana. In the coming weeks, the floodwaters will subside, and project collaborators will fly a helicopter along the 250 kilometres or so of coastline between the Atchafalaya and Mississippi deltas, landing at regular intervals

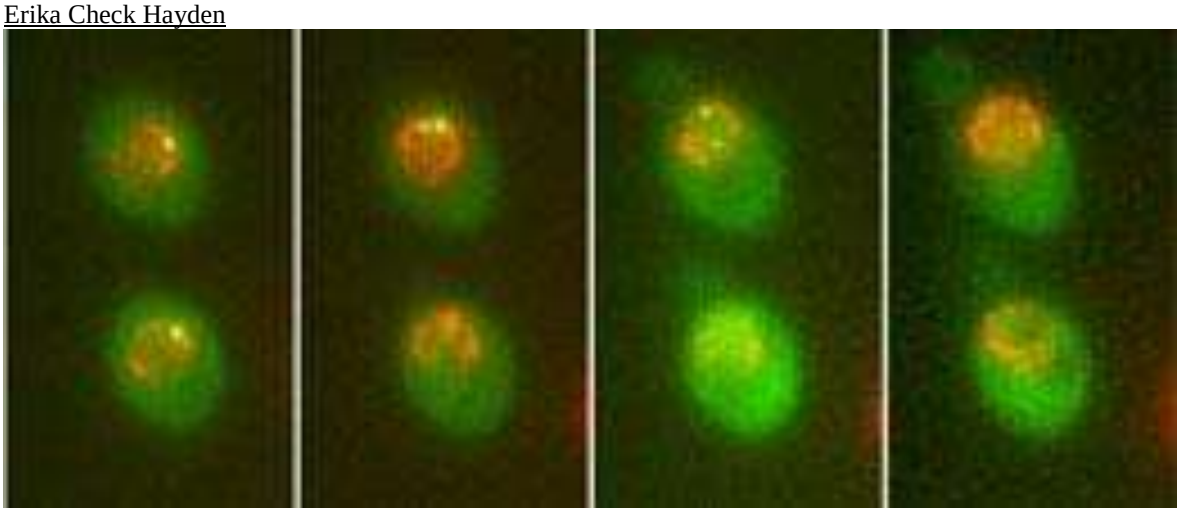
to take sediment samples and discover where the flood has added or eroded soil. Taken together, these measurements should help to determine which river characteristics can be tuned to build healthy marshes. Independent teams working farther up the river will add detail.

Besides shaping restoration plans, says Mathies, projects such as Falcini's could also help to build support for restoration measures, which will be expensive and could meet resistance from stakeholders such as fishermen and shipping interests. "We need to be able to show people what the returns will be," says Mathies. Louisiana officials have started to take a "generational view" of coastal restoration, accepting that long-term benefits trump short-term interests, says Robert Twilley, a coastal-systems ecologist at the University of Louisiana at Lafayette. The trick to maintaining a healthy coastline is to minimize the damage from floods while maximizing the benefits, he adds. "We need to think how we can reconfigure the river to accomplish both flood control and restoration."

http://www.nature.com/news/2011/110614/full/474259a.html

Life hackers seek new tools

Field aims to enlist techniques from molecular biology to attack fundamental challenges.
Erika Check Hayden



Real-time observation of yeast genes tagged to fluoresce when transcribed into RNA could help synthetic biologists to design better circuits.Science/AAAS

Julius Lucks has heard the criticisms of synthetic biology before: life is too complicated to be manipulated by human designers; those who try have managed to cobble together only rudimentary genetic circuits from a limited suite of parts; the results are notoriously unpredictable. Meanwhile, a few high-profile successes — such as last year's creation of a bacterium with a synthetic genome[1] — and enthusiastic claims that the field will solve a raft of complex health, environmental and engineering problems, only increase the pressure to deliver.

Lucks, however, is undaunted. Last month he, his wife and their young child moved across the United States, from Berkeley, California, to Ithaca, New York, where he will set up his first independent lab in the discipline at Cornell University. His optimism is representative of a new generation of synthetic biologists who are gathering to chart the course of their field this week at a conference at Stanford University in California.

Jeff Tabor, a bioengineer at Rice University in Houston, Texas, says that one goal of the conference, the fifth Synthetic Biology Meeting, is to bring more traditional molecular biologists "into the fold", both to counter their intrinsic resistance to the concept of re-engineering life and to co-opt their tools. "There is a real difference in the way that I and people younger than me see biology and think about studying cells," Tabor says, "but there are a tonne of scientists doing molecular biology work that is improving our ability to engineer biology."

For example, 'next-generation' sequencing machines, designed to vastly speed up the reading of genomes, can also offer synthetic biologists a better way to observe cellular behaviour. That in turn will help them design better circuits — for instance, by giving them a quantifiable readout of how a circuit's modifications affect its function. In a paper[2] published this month by Lucks and his colleagues at the University of California, Berkeley, the group inferred the three-dimensional shapes of small RNA molecules by sequencing the corresponding DNA, using a technique called SHAPE-Seq. That strategy could help synthetic biologists to screen large pools of RNA rapidly to find those with certain structural characteristics that could be incorporated into RNA circuits.

“There needs to be a frank and open discussion about funding in synthetic biology.”

Another tool that synthetic biologists hope to adopt was published in April[3] by a team led by structural biologist Robert Singer of the Albert Einstein College of Medicine in New York. By tagging particular genes with a signalling molecule that fluoresces every time the gene is transcribed, the researchers can watch and quantify transcription in real time. The work could give synthetic biologists the equivalent of an electrician's circuit tester, helping them to engineer more predictable biological circuits.

"Using a technology like this, you can see exactly what a circuit is doing and count the number of circuit signals that are being produced in real time in live cells," Tabor says. "This is exactly what we need to help us put circuits together."

Bioengineer Adam Arkin, Lucks' mentor at Berkeley, has pursued the idea that circuits can be made more reliable by basing parts on existing cellular components that already accomplish a certain function in the cell. Such 'mother parts' could be tweaked slightly to yield 'families' of parts with similar features that could carry out their functions independently and efficiently.

In April, the team published a proof of concept for this approach[4] in which they tweaked an RNA-based gene-regulation system to simultaneously control the expression of multiple genes in a cell from the bacterium Escherichia coli, and even make a simple RNA circuit. Because the system is entirely RNA-based, it eliminates the need to translate a messenger RNA into a protein regulator, thereby reducing the overall complexity of the system.

Another approach to complexity involves designing multicellular circuits in which each cell is a circuit component. This neatly skirts the dilemma of trying to insulate the parts of a circuit from one another within the cytoplasm of a single cell. Chris Voigt, who is moving from the University of California, San Francisco, to co-direct a new synthetic-biology institute at the Massachusetts Institute of Technology in Cambridge, has been pursuing this approach in his lab with colleagues who published their proof of principle last December[5].

"There's been a change in the scale of the problems that we can address, and this comes out of the tools that synthetic biology can provide," says Voigt. At the meeting, Voigt will describe his lab's attempts to re-engineer the way some organisms convert nitrogen into a useable form through a molecular pathway that involves dozens of genes.

Synthetic biologists have been organizing their own initiatives to tackle other obstacles. For instance, one of the field's key tenets is that off-the-shelf molecular 'parts' could be used to program cells to carry out specific functions, such as making a drug or a biofuel. But such ambitious goals depend on the quality of the available parts[6]. So, in late 2009, an initiative called the BIOFAB (International Open Facility Advancing Biotechnology), funded by the US National Science Foundation, began working to design reliable parts with known functions. The BIOFAB has now made about 3,000 well- characterized parts and has released around 500 as a higher-quality curated collection.

Yet money is scarce for this kind of work — a challenge to be addressed at a conference workshop that will include funding agencies and industry. "There needs to be a frank and open discussion about funding in synthetic biology, especially in the United States," says Pam Silver, a systems biologist at Harvard University in Boston, Massachusetts. The bread-and-butter work that the field needs, such as fine-tuning circuitry, is more applied than most 'hypothesis-driven' research that is the remit of agencies such as the US National Institutes of Health. And most funders want applicants to focus on specific agendas, such as health or biofuels.

Indeed, Rob Carlson, a principal at the engineering, consulting and design company Biodesic in Seattle, Washington, wonders whether the field of synthetic biology is big enough to become a well-oiled engineering machine. This week's conference is sold out at 700 attendees, with a waiting list of at least 100, but as Carlson points out, many of those attending will be reporters and investors.

"Given the complexity of the task at hand, it doesn't surprise me at all that we are still going slowly," says Carlson.

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Psychopharmacology in crisis

Researchers warn of 'withdrawal of hope' as funding shrivels.
Daniel Cressey

Patients face a "withdrawal of hope" as neuropsychopharmacology funding falters.SOVEREIGN, ISM/SCIENCE PHOTO LIBRARY

Many people affected by mental illness are facing a bleak future as drug companies abandon research into the area and other funding providers fail to take up the slack, according to a new report.

Produced for the European College of Neuropsychopharmacology (ECNP), the report warns that "research in new treatments for brain disorders is under threat". With current treatments inadequate for many patients, it says, "withdrawal of research resources is a withdrawal of hope for patients and their families"[1].

A number of formerly big players in neuroscience have all but abandoned the area recently as the pharmaceutical industry has undergone massive restructuring. AstraZeneca and GlaxoSmithKline have both cut research funding and closed down entire teams dedicated to developing drugs for psychiatric disorders.

"These are dark days for brain science."
David Nutt
Imperial College London

Although some of the problems faced by the field also apply to other sections of the pharmaceutical industry, many are specific to researchers trying to hit targets in the brain.

David Nutt and Guy Goodwin, who authored the report following a recent ECNP meeting on the topic, note that it can take much longer to develop medicines for psychiatric disorders than for better-understood conditions such as cancer, and that potential drugs for psychiatric conditions have higher failure rates. These failures sometimes become apparent only late in the development process, making neuroscience an expensive and risky prospect for industry.

The coming crisis

Nutt, a neuropsychopharmacologist at Imperial College London, told reporters at a press conference in London on 13 June that "these are dark days for brain science".

Both authors add that, in addition to the dearth of pharmaceutical funding, there is still a stigma surrounding conditions such as depression. This feeds through into the money donated to advocacy groups. "Almost nothing" comes from charity groups for mental-health research, compared with huge charity funding in areas such as cancer, notes Goodwin, head of psychiatry at the University of Oxford, UK.

He warns of a "generational crisis" in terms of both training and capacity to develop new drugs for conditions such as depression and dementia, unless the withdrawal of pharmaceutical funding is addressed.

This warning is echoed by an editorial published last week in the British Journal of Clinical Pharmacology (BJCP). 'Vanishing clinical psychopharmacology', written by Joop van Gerven and Adam Cohen of the

Leiden University Medical Centre in the Netherlands, outlines the perilous state of the field[2]. Over the past year, the authors write, the BJCP has published only five papers in this area, none of which involved novel drugs.

At the 2011 meeting of the American Society for Clinical Pharmacology and Therapeutics, only 13 of 300 abstracts related to psychopharmacology and, again, none related to novel drugs. This situation mirrored that at the 2010 Collegium Internationale Neuro-Psychopharmacologicum, where 8 of 870 abstracts were on human psychopharmacology and four were on "new or relatively new mechanisms of action", they report.

The road ahead

Cohen says that much of the problem derives from a failure to develop the underlying science. Depression is a complex disease, yet to assess whether drugs work, researchers have to rely on crude tools such as questionnaires.

"People have not paid enough attention to how to measure depression, how to measure psychosis," he says. "When we develop new drugs, we still measure on these basic scales."

Developing new ways of assessing brain function and disease will reduce the risks in developing new drugs, van Gerven and Cohen argue in their editorial.

Nutt and Goodwin also suggest a number of ways forward. Patents could be longer-lived for drugs that take longer to develop, such as those for brain disorders, to encourage companies to work in the area. And researchers should lobby for European funding — such as that available from the Framework programme initiative — to set brain research as a priority.

Academia could also develop more creative relationships with industry in order to fill the gap in drug development, they argue. The ECNP is pushing the idea of a 'medicines chest', to which companies can assign compounds they are no longer actively developing to be taken forward by researchers in academia or elsewhere. Nutt says that several companies have already expressed an interest in this idea.

If the current research base is allowed to evaporate, Nutt warns, it will be decades before it can be built up to start again.

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LEED the Gold Standard in Green?

A lawsuit challenges the claims of the nation's foremost green building effort — the Leadership in Energy and Environmental Design (LEED certification) program.

By Ben Ikenson

An artist's rendering of Henry Gifford's 803 Knickerbocker in Brooklyn, a project expected to be the first new apartment building in the U.S. to conform to the European Passivhaus standard, a very strict set of guidelines that enables architects to create buildings so energy-efficient they do not need a conventional heating system. (Courtesy Henry Gifford)

It is telling that the Creation Museum in Petersburg, Ky., wants the design of a biblical theme park that will showcase a 500-foot-long replica of Noah's Ark to qualify for certification by the Leadership in Energy and Environmental Design program, an industry standard for sustainable buildings.

Mike Zovath, senior vice president of Answers in Genesis, the "apologetics (i.e., Christianity-defending) ministry" that built the museum, is a climate change skeptic who told *The Washington Post* that he liked the idea of energy efficiency: "There is a pretty significant return on investment," he said.

Whatever the motive, even conservative religious groups, historically far from the environmental forefront, are embracing the tenets of green building — or at least those promulgated by the U.S. Green Building Council, the member-based nonprofit that runs the program commonly known as LEED. A marketer's dream come true, the program, which features a multifaceted approach to construction, is the most recognized name in green building in the country.

But one Doubting Thomas is effectively disparaging the program's phenomenal success.

Henry Gifford has made his living designing mechanical systems for energy-efficient buildings in New York City. And he admits the program has popularized the idea of green building: "LEED has probably contributed more to the current popularity of green buildings in the public's eye than anything else. It is such a valuable selling point that it is featured prominently in advertisements for buildings that achieve it. LEED-certified buildings make headlines, attract tenants and command higher prices."

But for years, Gifford has been a tenacious and vocal opponent of LEED, claiming that the program's "big return on investment" is more a matter of faith than fact, and that LEED simply "fills the need for a big lie to the public." Last October, Gifford filed a class-action lawsuit for more than $100 million against the USGBC, accusing the nonprofit of making false claims about how much energy LEED-certified buildings actually save and using its claims to advance a monopoly in the market that robs legitimate experts — such as himself — of jobs.

In February, the complaint was amended and restructured as a conventional civil suit, with Gifford and three other plaintiffs seeking injunctive relief and monetary damages for lost sales and profits and related harm. While dropping the antitrust claims, among others, in the initial complaint, the plaintiffs continue to allege that the council has engaged in false advertising and deceptive practices.

While the council wouldn't comment on ongoing litigation, in April it filed a motion for dismissal, accompanied by a 29-page memorandum arguing that the plaintiffs lack standing and have failed to state a claim upon which relief could be granted. While acknowledging that Gifford — described in the memorandum as "a longtime gadfly, preoccupied with critiquing USGBC and LEED through the media, internet forums and the like" — has the right to voice his criticisms to his heart's content, the council argues he doesn't have a case.

Henry Gifford (Photo by Travis Roozee)

Gadfly or not, many green building industry experts would agree that Gifford is shedding light on a crucial issue. Other critics have pointed out examples of sporadic energy performance shortfalls with LEED buildings

in the past. Gifford has thrown down a gauntlet which, in conjunction with other forces, is likely to influence the future course of energy conservation.

Green building, as we know it today, began taking shape in the 1990s, as public concern over climate change and waning fossil fuels led to a concerted effort to find and address the culprits — and that ultimately fingered the built environment. Architecture 2030, a nonprofit committed to environmental sustainability, used data from the U.S. Energy Information Administration to conclude that the building sector was responsible for 46.9 percent of carbon dioxide emissions in the U.S. in 2009, almost half again as much as the 33.5 percent generated by transportation sources, such as cars, that are usually spotlighted.

The building sector consumes 49 percent of all energy produced in the United States, and 77 percent of all the electricity produced in the nation is used to operate buildings. Experts believe those figures are similar in industrial countries worldwide.

Inspired by another green building program in the United Kingdom, the Green Building Council devised its own and officially launched LEED in 2000. Crafted to measure a building's "greenness," the program features a point system to score a checklist of considerations in various categories, from sustainable site development to materials selection to energy efficiency. Those seeking certification pay a registration fee and, if approved, a certification fee based on square footage. After review of requisite documentation, certification may be awarded at one of four levels: certified, silver, gold and, the most coveted, platinum.

Today, nearly 8,000 commercial projects covering a billion square feet are certified, and nearly 32,000 other commercial projects with more than 6 billion square feet are registered. On the residential side, more than 9,000 homes are certified and more than 40,000 others are registered. Also, more than 150,000 individuals from various building-related fields have become LEED Accredited Professionals, a credential that demonstrates program expertise.

"The LEED system has changed the market for environmentally friendly buildings in the U.S.," Gifford says. "But there is an enormous problem: The best data available show that on average, they use more energy than comparable buildings. What has been created is the image of energy-efficient buildings, but not actual energy efficiency."

Gifford's contentions rely heavily on data from a 2008 National Buildings Institute study, partly funded by the Green Building Council, to examine energy performance of LEED-certified commercial buildings. Currently the most comprehensive public body of data on the subject, the study analyzed energy use of certified buildings and compared that with average energy use of commercial buildings as reported by the Energy Department.

"On average," the study concluded, "LEED buildings are 25 to 30 percent more efficient than non-LEED buildings."

Using the study's data but not its analysis, Gifford released his own report, claiming that when interpreted accurately, the data show LEED-rated buildings actually use 29 percent more energy.

At the time, 552 buildings had been LEED-certified, and the study examined data from 121. Gifford says the initial problem is that numbers were reported only from willing building operators. It's "a little like making generalizations about drivers' blood alcohol levels from the results of people who volunteer for a roadside Breathalyzer test," he wrote.

Gifford offers other critical analyses. For one, the study compares LEED buildings with the Energy Department's data set for all existing buildings, when, he says, they should have been compared to data for (presumably more efficient) new buildings only.

But this complaint may be off-base. "Buildings older than 1960 are typically more efficient than newer buildings," says Tristan Roberts, editorial director for the independent industry news source BuildingGreen.com. "So if anything, comparing LEED buildings against the whole data set may be a more rigorous comparison"

Indeed, before electricity became cheap and plentiful, buildings were relatively efficient because they often included features such as thick masonry walls and simpler mechanical systems. Plus, tenants and building owners now increasingly fill structures with electric devices such as home electronics, computers and security systems.

Oberlin College physicist John Scofield, for one, believes that the heavy reliance on cheap electricity among building professionals helps account for the increased energy usage by new buildings. "The owner and architect delude themselves into believing that one day electricity will be green," he says. The reality, of course, is that electric energy from the grid is dirty."

Originally drawn to the issue by Gifford's report, Scofield examined the National Building Institute study and presented his own findings critical of LEED's claims at the 2009 International Energy Program Evaluation Conference.

"There is no justification for claims that LEED-certified commercial buildings are using significantly less electricity or have significantly lower greenhouse-gas emissions associated with their operations than do conventional buildings," he says. "LEED buildings do not save energy."

His conclusion is based on how LEED buildings measure efficiency by using "site energy" and not "source energy."

Measured at the building, site energy is the amount of heat and electricity represented in utility bills. It does not, however, account for the conversion of primary energy sources into electricity, which delivers more than half of the energy consumed by typical buildings. Generation of electricity elsewhere and transmitting it to a building is quite inefficient; three BTUs of energy are required to produce one BTU of electricity. Source energy measurement therefore more accurately reflects the true on- and off-site energy costs for a particular building.

"That's why the Environmental Protection Agency's Energy Star program, for one, has proven to be a much better guideline, because it uses source energy as a metric for scoring buildings," Scofield says. Energy Star was established in the early 1990s to help power plants reduce energy use and greenhouse gas emissions, and has become an international standard for products ranging from computers and appliances to entire buildings.

Scofield also notes that, in the study, no correlation was found between the number of program points awarded in LEED's category for energy efficiency and actual measured energy reduction. "The problem here is that LEED scores are based on projected energy use — calculated before construction begins," he says. "In contrast, Energy Star scores are based entirely on measured source-energy consumption."

The Green Building Council has been addressing some of these criticisms since before Gifford's suit. Since 2009, it has required all certified buildings to provide performance data to track predicted savings against actual savings. In 2008, in a program for existing buildings, LEED required the applicant to report and monitor energy consumption for at least a year prior to certification.

Regardless, how the council faces another challenge will likely be relevant to the plaintiffs. As many local governments clamor to embrace sustainable building, the group has been working with industry organizations to translate LEED into standardized, optional, code-friendly language that municipalities can readily adopt. Paradoxically, widespread standardization of LEED certification may help competitors appeal to consumers who want more than what their codes prescribe.

"As these practices become standardized, how much will the general population care about green 'plus,' since LEED certification has a perceived prohibitive cost?" asks Shari Shapiro, an attorney who serves on the council's legal advisory board. "If done well, LEED will evolve into something new."The rating program is being reinvented; the council expects to release a new version of the program in November 2012. An initial public comment period that began last November generated more than 5,000 remarks; another comment period is expected to begin this July.

"There is certainly part of me that is pleased the industry is restless," says Brendan Owens, the council's vice president of LEED technical development. "What I think is unproductive is to paint with too broad a brush. If you don't like one thing about LEED, it's not a reason to dismiss everything about it."Many LEED supporters point out that energy efficiency is not the only facet of the program, nor of the green building movement it helped galvanize. Water conservation, green materials and proximity to mass transit are among other major considerations of the LEED's holistic approach.

Still, if energy performance continues to be an Achilles' heel for LEED, other more energy-focused green options exist, such as Energy Star, which Scofield endorses.Gifford himself is designing a system for 803 Knickerbocker in Brooklyn — what's expected to be the first new apartment building in the U.S. to conform to the Passivhaus standard, an import from Germany that emphasizes insulation.

Ironically, Gifford's lawsuit — like the interest in LEED by the Creation Museum — may be a measure of the program's success. "Coca-Cola gets sued all the time," Shapiro says. "Why? Because they're Coca-Cola. A suit against the USGBC marks the arrival of green building."

Others, like Edward Mazria, founder of Architecture 2030, see the suit as indicative of a rapidly evolving industry: "When you have tremendous activity, you also have tremendous scrutiny."

Mazria's organization issued the 2030 Challenge, asking building professionals, governments and industry to reduce fossil-fuel energy consumption by all types of buildings from 2003 levels by 60 percent by 2030. The program also sets increasingly tighter standards so that all new buildings and major renovations will be "carbon neutral" by 2030 as well. Almost all professional organizations, including the Green Building Council, the federal government and many cities and states, have taken up the challenge through resolutions, executive orders and legislation.

"Two major events — the meltdown of the Fukushima nuclear plant in Japan and the U.N. entering the confrontation in Libya — are examples of a larger perpetual drama playing out in order to meet voracious building-sector energy demand," Mazria says. "The transformation away from this will stem from the architecture, engineering and planning community, which configures the entire built environment. We set the agenda — and that agenda is changing. Regardless of any contentious issues, the transformation of the building sector is under way."

The real question, he suggests, isn't which well-intentioned program does what: "The question is: Will it happen quickly enough to avert major global issues?"

http://www.miller-mccune.com/environment/is-leed-the-gold-standard-in-green-32180/?utm_source=Newsletter165&utm_medium=email&utm_content=0614&utm_campaign=newsletters

Designing for Impact and Emotion

Two recent design international conferences exult in the future of design, which can be harnessed to solve social problems as well as sell mobile phones.

By Sally Augustin

Design is the basis for almost everything, from what we sit on to what we drive to how we react visually to everyday objects. Two recent conferences discussed how the discipline can effect the future. (istockphoto)

Design matters.

A lot.

The Institute of Design at the Illinois Institute of Technology in Chicago is determined to show the world how and how much. At two recent conferences it has hosted, one in May and one last October, the power of design and thinking in a designer-ly way were thoroughly discussed and demonstrated. As Patrick Whitney, the dean of IIT's Institute of Design describes, understanding design "in both a deeper and broader way … can create value for both culture and commerce over the long run."

And design isn't just an esoteric pursuit; it encompasses all aspects of day-to-day life from the layout of the magazine you read on your iPad to the function and aesthetic look of the iPad itself. It's how you feel in a comfy chair, how you react to the sight of a dentist's drill or how you feel walking up a flight of stairs. Experts are finding ways to utilize design in new ways that will economize, green and sustain the environment — indoors and out. Design impacts all of these things. It's a living, breathing discipline.

So, in May, the IIT Institute of Design organized its annual Strategy Conference. As the event's promotional materials clearly state, this is "an international executive forum addressing how business can use design to explore emerging opportunities, solve complex problems, and achieve lasting strategic advantage."

Attendees considered design as an instrument for effective change. It works its magic when its processes are applied to resolve complex problems in ways that support human well-being and organizational welfare (that would be via profit and competitive advantage, for the naïve). Design thinking is particularly useful for effectively and efficiently resolving the wicked problems prevalent today because it both structures and liberates inspired problem solving. It simultaneously harnesses creativity and rationality.

Because of its focus on understanding users, redefining problems and generating solutions that comprehensively enhance human experience, design can — and increasingly does — play an important role in resolving world problems.

For example, at the conference, Connie Yowell, director of education in the MacArthur Foundation's U.S. programs, and self-described "chief of confusion" John Seeley Brown discussed thorny educational issues that on their surface might not seem ripe for a discussion on design. Her particular focus is harnessing digital media, and his is developing learning environments that cultivate imagination in a world of constant change.

Bill Moggridge, director of the Smithsonian's Cooper-Hewitt, National Design Museum spoke eloquently of the need for leaders to use design processes to better resolve the challenges that they face. Kun-Pyo Lee, head of the corporate design center and executive vice president at LG Electronics, revealed the importance of design thinking to his efforts. (An interview with *BusinessWeek* gives a taste if his comments.) Similar themes were struck by Ted London, a faculty member at the University of Michigan's Ross School of Business whose passion is helping small-business owners in the developing world create enterprises that flourish.

Other speakers confirmed the value of design in additional contexts — economic, social and physical.

Robots that communicate in just the right way, traveler experiences at airports, dental drills that aren't quite as terrifying, the way that cars "look" at us, the sound of heeled shoes and the distance between tables in restaurants. These things were among the topics discussed at the seventh International Conference on Design and Emotion last October at IIT.

The society's membership is worldwide, and attendees tend to be a pleasant sort — they know more clearly than most the implications of a phrase or gesture, for example. There are academics and members of nonprofit organizations in their midst, along with people whose paychecks are issued by major multinationals.

Mark Johnson, a philosophy professor at the University of Oregon, set the tone for the conference. Johnson's work explores the ways that aesthetics are the foundation of our experience and understanding of our world. He focuses on the way our bodies engage with our environments and how we derive meaning from these interactions. Meaning, thus, comes through sensory experience, and we inhabit the world through metaphors. His work blends philosophy and science, and epitomizes the interdisciplinary and innovative material presented throughout the conference.

His blend of science and philosophy resonated with the attendees. Johnson parsed the words and melody of the song "Over the Rainbow" to illustrate how sensory experience can generate an emotional response. He also discussed emotional reactions to curved versus jagged lines.

Johnson exposed the fundamental nature of our psychological interactions with the world around us, and then Cynthia Breazeal, associate professor of media arts and sciences at the Massachusetts Institute of Technology's Media Lab, discussed how to develop natural interactions between people and robots.

She detailed MIT's studies of robots that use their own experiences to learn from humans. The robots birthed in Breazeal's lab are termed "socially intelligent." As the introduction to her talk printed in the program describes, these sorts of robots "interact and communicate with people in human-centric terms, work with humans as peers, and learn from people as an apprentice."

Perhaps humans aren't as sophisticated as we like to think.

Several speakers discussed ways in which lighting can influence hotel stays and shopping trips, for example. While that might sound mercenary, the focus of most attendees has moved beyond simply creating pleasurable experiences to motivating sustainable and healthful behaviors. Presenters acknowledged that sometimes experiences can't be made pleasurable but can be made better (the dental drill mentioned above) or that if handled in just the right way "negative" emotions can also be used to support rich product experiences.

People designing systems that encourage workers to burn off a few extra calories in their walks around their workplaces want to create a positive system-employee interaction instead of one that calls to mind Army boot camp (the old Army boot camp, not the newer, chummier boot camp). People developing medical decision aids truly want patients' emotions to be influenced in an optimal way by the design elements conveying information.

One session talked about designers navigating through a space without using their sense of sight so that they could better design for blind people. Another technique, in-depth interviewing, was used to understand the interiors and furniture needs of people "in the third age."

The idea of designing total experiences was also a conference theme. In the West, vision is generally the sense that receives the most attention and therefore is often the one upon which designers focus their attention. Extolling designers to move beyond what something looks like and to recognize the emotional experiences generated through the other senses, Juliana Neves and Vera Damazio from the Pontificia Universidade Catolica de Rio de Janeiro discussed the experience of being in the Blur Building.

The Blur Building wasn't a building in any of the traditional meanings of the term; it was a cloud designed by the firm Diller Scofidio + Renfro above Switzerland's Lake Neuchatel. The mist and fog engineered into the structure actively and consciously engaged the sense of touch, for example. Neves and Damazio believe that design for all of the senses is crucial consideration during the development of situations and experiences.

http://www.miller-mccune.com/environment/designing-for-impact-and-emotion-32107/

High Wired: Does Addictive Internet Use Restructure the Brain?

Brain scans hint excessive time online is tied to stark physical changes in the brain
By Dave Mosher | June 17, 2011 | 4

Image: dionhinchcliffe/Flickr

Kids spend an increasing fraction of their formative years online, and it is a habit they dutifully carry into adulthood. Under the right circumstances, however, a love affair with the Internet may spiral out of control and even become an addiction.

Whereas descriptions of online addiction are controversial at best among researchers, a new study cuts through much of the debate and hints that excessive time online can physically rewire a brain.

The work, published June 3 in *PLoS ONE*, suggests self-assessed Internet addiction, primarily through online multiplayer games, rewires structures deep in the brain. What's more, surface-level brain matter appears to shrink in step with the duration of online addiction.

"I'd be surprised if playing online games for 10 to 12 hours a day didn't change the brain," says neuroscientist Nora Volkow of the National Institute on Drug Abuse, who wasn't involved in the study. "The reason why Internet addiction isn't a widely recognized disorder is a lack of scientific evidence. Studies like this are exactly what is needed to recognize and sette on its diagnostic criteria," if it is a disorder at all, she says.*

Defining an addiction

Loosely defined, addiction is a disease of the brain that compels someone to obsess over, obtain and abuse something, despite unpleasant health or social effects. And "internet addiction" definitions run the gamut, but most researchers similarly describe it as excessive (even obsessive) Internet use that interferes with the rhythm of daily life.

Yet unlike addictions to substances such as narcotics or nicotine, behavioral addictions to the Internet, food, shopping and even sex are touchy among medical and brain researchers. Only gambling seems destined to make it into the next iteration of the Diagnostic and Statistical Manual of Mental Disorders, or DSM, the internationally recognized bible of things that can go awry with the brain.

Nevertheless, Asian nations are not waiting around for a universal definition of Internet addiction disorder, or IAD.

China is considered by many to be both an epicenter of Internet addiction and a leader in research of the problem. As much as 14 percent of urban youth there—some 24 million kids—fit the bill as Internet addicts, according to the China Youth Internet Association. By comparison, the U.S. may see online addiction rates in urban youth around 5 to 10 percent, say neuroscientists and study co-authors Kai Yuan and Wei Qin of Xidian University in China.

The scope of China's problem may at first seem extraordinary, but not in the context of Chinese culture, says neuroscientist Karen M. von Deneen, also of Xidian University and a study co-author.
Parents and kids face extreme pressure to perform at work and in school, but cheap Internet cafes lurk around the corner on most blocks. Inside, immersive online game realities like World of Warcraft await and allow just about anyone to check out of reality.
"Americans don't have a lot of personal time, but Chinese seem to have even less. They work 12 hours a day, six days a week. They work very, very hard. Sometimes the Internet is their greatest and only escape," according to von Deneen. "In online games you can become a hero, build empires, and submerge yourself in a fantasy. That kind of escapism is what draws young people."
Out of sight of parents, some college kids further cave to online escapism or use gaming to acquire resources in-game and sell them in the real world. In a recent case Chinese prison wardens allegedly forced inmates into the latter practice to convert digital gold into cold-hard cash.

Several studies have linked voluntary and excessive online use to depression, poor school performance, increased irritability and more impulsiveness to go online (confounding addicts' efforts, if they want to at all, to stop pouring excessive time into online games). To study the effects of possible Internet addiction on the brain, researchers began with the Young Diagnostic Questionnaire for Internet addiction.
This self-assessment test, created in 1998 by psychiatrist Kimberly Young of Saint Bonaventure University in New York State, is an unofficial standard among Internet addiction researchers, and it consists of eight yes-or-no questions designed to separate online addicts from those who can manage their Internet use. (Questions range from, "Do you use the Internet as a way of escaping from problems or of relieving an anxious mood?" to "Have you taken the risk of losing a significant relationship, job, educational or career opportunity because of the Internet?".)
The China-based research team picked 18 college-age students who satisfied addict criteria, and these subjects said they spent about 10 hours a day, six days a week playing online games. The researchers also selected 18 healthy controls who spent less than two hours a day online (an unusually low number, says von Deneen). All of the subjects were then plopped into an MRI machine to undergo two types of brain scans.

Brain drain

One set of images focused on gray matter at the brain's wrinkled surface, or cortex, where processing of speech, memory, motor control, emotion, sensory and other information occurs. The research team simplified this data using voxel-based morphometry, or VBM—a technique that breaks the brain into 3-D pixels and permits rigorous statistical comparison of brain tissue density among people.
The researchers discovered several small regions in online addicts' brains shrunk, in some cases as much as a 10 to 20 percent. The affected regions included the dorsolateral prefrontal cortex, rostral anterior cingulate cortex, supplementary motor area and parts of the cerebellum.
What's more, the longer the addiction's duration, the more pronounced the tissue reduction. The study's authors suggest this shrinkage could lead to negative effects, such as reduced inhibition of inappropriate behavior and diminished goal orientation.
But imaging neuroscientist Karl Friston of University College London, who helped pioneer the VBM technique, says gray matter shrinkage is not necessarily a bad thing. "The effect is quite extreme, but it's not surprising when you think of the brain as a muscle," says Friston, who was not involved in the study. "Our brains grow wildly until our early teens, then we start pruning and toning areas to work more efficiently. So these areas may just be relevant to being a good online gamer, and were optimized for that."
(Friston says London taxi drivers provide a telling comparative example of the brain's ability to reshape itself with experience. In the 2006 study, researchers compared taxi drivers' brains with those of bus drivers. The former showed increased gray matter density in their posterior hippocampi—a region linked to maplike spatial navigation and memory. That probably comes as no surprise to London cabbies, who spend years memorizing a labyrinthine system of 25,000 streets, whereas bus drivers have set routes.)
As another crucial part of the new study on Internet addiction, the research team zeroed in on tissue deep in the brain called white matter, which links together its various regions. The scans showed increased white matter density in the right parahippocampal gyrus, a spot also tied to memory formation and retrieval. In

another spot called the left posterior limb of the internal capsule, which is linked to cognitive and executive functions, white matter density dropped relative to the rest of the brain.

Disorder under construction

What the changes in both white and gray matter indicate are murky, but the research team has some ideas. The abnormality in white matter in the right parahippocampal gyrus may make it harder for Internet addicts to temporarily store and retrieve information, if a recent study is correct. Meanwhile, the white matter reduction in the left posterior limb could impair decision-making abilities—including those to trump the desire to stay online and return to the real world. The long-term impacts of these physical brain changes are even less certain. Rebecca Goldin, a mathematician at George Mason University and director of research for *STATS*, says the recent study is a big improvement over similar work published in 2009. In this older study a different research group found changes in gray matter in brain regions of Internet addicts. According to Goldin, however, the study lacked reliable controls.

The sample sizes of both studies were small—fewer than 20 experimental subjects each. Yet Friston says the techniques used to analyze brain tissue density in the new study are extremely strict. "It goes against intuition, but you don't need a large sample size. That the results show anything significant at all is very telling," Friston notes.

In the end all of the researchers interviewed by *Scientific American* emphasized significance only goes so far in making a case for IAD as a true disorder with discrete effects on the brain. "It's very important that results are confirmed, rather than simply mining data for whatever can be found," Goldin says.

http://www.scientificamerican.com/article.cfm?id=does-addictive-internet-use-restructure-brain

Spoonfuls of Medicine, Marketed for Centuries

By ABIGAIL ZUGER

Posters From The Philadelphia Museum of Art, The William H. Helfand Collection
When images overtook text in patent medicine advertisements, 19th century visions of health flowered in profusion all over the world. “Man as Industrial Palace,” center, is a work that combines the Lilliputian charms of “Where’s Waldo?,” Willy Wonka’s factory, the world’s best dollhouse and a fun pinball game

Everyone knows you can’t buy health, but that has never stopped anyone from trying to sell it to you. As a small, gorgeous and fiercely funny exhibition of posters at the Philadelphia Museum of Art makes clear, the marketing of this particular noncommodity is an enduring art in every sense of the word.

The basic gambit has probably not changed since the Stone Age: a concerned stranger presents you with a vision of the future, starring either a happier, better you with the use of a certain product, or a sadder-but-wiser, considerably more miserable you without it. For centuries all was word of mouth, but with the birth of the modern poster in the late 19th century the visions suddenly became visual, flowering in large and colorful profusion all over the world.

Early adopters straddled the Atlantic. In the United States they included Prof. P. H. van der Weyde, M.D., inventor of the genuine German Electro Galvanic Belt for ailments including liver, stomach and kidney diseases (“beware of imitations”), and M. K. Paine, a pharmacist in Windsor, Vt., who compounded Green Mountain Balm of Gilead from the resins of local evergreens.

In France, the famous Dr. Guillaume Dupuytren, having devised an operation for a hand condition that still bears his name, moved on to the presumably more lucrative problem of baldness before he died in 1835. His hair-strengthening pomade was still going strong in the 1860s, celebrated in respectful neoclassical style against a hot pink background.

The familiar verbal effluvia of the patent medicine industry clutter some early posters. The Green Mountain balm is “universally acknowledged to be the best Plaster ever known,” with an entire paragraph in small print enumerating its target ills, from pain and internal inflammation through lameness, boils and corns. Dr. Trikos, purveyor of an eponymous lotion for irritations of the skin and baldness, summarized it all eloquently: “I have cured myself, I have cured my friends, and I wish to cure all who suffer.”

The words eventually fell away, though, and the images took center stage, helped along by some of the best-known poster artists of the time.

Jules Chéret, the master of Belle Époque poster art, dispatched two of his vivacious gauze-clad young women to the cause of Vin Mariani, the wine that refreshes body and brain and restores health and vivacity. Each demoiselle gaily pours herself a glass; for neither, clearly, is it her first. Leonetto Cappiello, the Italian-born French artist called "father of modern advertising," created an ecstatic senior citizen dancing in dressing gown and slippers after Uricure repaired his joints.

Drinking buddies every bit as unforgettable as the glorious Parisiennes were sketched by an anonymous Hungarian artist, but here the tall guy in charge of the bottle has a black robe and a skull's head, while his small, flushed companion in baggy work clothes and a large droopy mustache is clearly headed for trouble. (A temperance philanthropy was behind that one.) Skulls are deployed elsewhere to make dire points about syphilis, while a gigantic black spider does the honors for TB.

But the star of the show may be the single image intended neither to cajole nor to terrify but to educate and amuse. The five-volume anatomy and physiology textbook that the German physician Fritz Kahn brought out in the 1920s was illustrated with a poster-size folding color plate depicting "Man as Industrial Palace," a work that combines the Lilliputian charms of "Where's Waldo?," Willy Wonka's factory, the world's best dollhouse and a really good pinball game.

Up in the chambers of the brain, two groups of tiny men in suits and ties deliberate around small conference tables: they are, of course, Will and Reason. Nearby a lone fellow in shirtsleeves and headphones operates a telegraph: he is Hearing, while the photographer one cubicle over is Sight.

Gears move particles of food along the alimentary tract, aided by tiny workers with rakes and cauldrons of digestive enzymes. Down in Bone Marrow a solitary artisan stamps out red blood cells.

It is an image begging to be animated, and the contemporary German designer Henning M. Lederer has done just that, in a short film looping alongside the actual lithograph. There is no need to travel to Philadelphia for this particular pleasure, though; Mr. Lederer's utterly irresistible creation is online at http://www.vimeo.com/6505158.

Any immersion in medical history is likely to produce a stereotyped set of reflections on the remarkably short lifespan of most good medical advice and the remarkably enduring nature of the motivations behind it. Altruism and the hard sell have always been intertwined. In fact, William H. Helfand, a retired Merck executive and collector of medical memorabilia whose many donations to the museum include the 50-odd items in the show, goes on record in the catalog ruefully acknowledging patent medicine salesmen as his "figurative ancestors."

The bold images on display here prompt one more reflection. As our technical understanding of health becomes ever more pixilated in dull shades of gray, muted by risk and benefit and by statistical slicing and dicing, the giant assertions splashed over these gallery walls are more appealing than ever.

Just tell me what to do, they say. Give me something that will work. No doctor today can do either one, not without a lot of disclaimers, but that doesn't mean anyone has stopped asking.

"Health for Sale: Posters From the William H. Helfand Collection" is at the Philadelphia Museum of Art through July 31.

http://www.nytimes.com/2011/06/21/health/21posters.html?_r=1&nl=health&emc=healthupdateema2

Keeping Score on How You Take Your Medicine

By TARA PARKER-POPE

Stuart Bradford

Most people are well aware that companies compile credit scores on just about everyone. Now, one company is planning to rate how likely people are to take prescribed medication.

Nearly three in four Americans do not follow doctor's orders for taking prescription drugs, a problem that is associated with 125,000 patient deaths each year, according to the National Consumers League. One in three patients never even fills the prescription. Others forget to pick up their drugs from the pharmacy, skip doses, take their pills at the wrong time or take too much or too little. And even for those who follow recommendations at the start, some eventually stop taking the medication altogether.

But which patients are likely to take their prescription medications correctly and which ones are likely to deviate from the plan? FICO, a company whose credit score is widely used to assess the credit worthiness of millions of consumers, is planning to answer that question. It has developed a new FICO Medication Adherence Score that it says can predict which patients are at highest risk for skipping or incorrectly using prescription medications.

"We started thinking about how do consumers behave as patients," said Mark Greene, the chief executive of FICO, based in Minneapolis. "The problem, from a math standpoint, is not all that different from banking and other industries."

FICO officials say insurance companies and other health care groups will use the score to identify those patients who could benefit the most from follow-up phone calls, letters and e-mails to encourage proper use of medication. By the end of the year, an estimated two million to three million patients will have been given a FICO medication adherence score and a total of 10 million patients are expected to be scored during the next 12 months, the company said. Those estimates are based on current negotiations with health care companies who plan to use the scoring system.

The FICO medication score is based on publicly available data, like home ownership and job status, and does not rely on a patient's medical history or financial information to predict whether he or she will take medication as directed. So, like a credit rating, it can be compiled without a person's knowledge or permission.

The score was created using data from a large pharmacy benefits manager that provided information for a random sample of nearly 600,000 anonymous patients with diabetes, heart disease and asthma. Using the data set, FICO was able to track the patterns of patients who filled and refilled prescriptions and those who didn't. The company used the data to identify the variables most associated with medication adherence and developed a risk score on a scale of 0 to 500.

Patients who score 400 and above are likely to take medication as prescribed, while those below 200 are at high risk and need more follow up and regular reminders.

Mr. Greene said the company chose a different scale for its medication score so it would not be confused with the FICO score, which ranges from 300, representing a poor credit risk, to 850, a good credit risk.

"We didn't want any confusion or suggestion that these things are interchangeable," he said.

Among the factors that influence medication adherence risk are job and home stability. People who have been in a job or home for only a short period of time are at higher risk of not taking their medications correctly. Social support is also a factor. People who live alone or are unmarried are more likely to skip medications or not fill prescriptions.

Age also influences this behavior. Young adults, particularly college students, are at high risk of not following doctor's orders. So are people over 80. People who don't own a car are at higher risk than those who do.

And while gender alone is not predictive of medication compliance, FICO found that women are less likely than men to follow a doctor's orders for taking prescription drugs. That finding is surprising given that women, in general, are more likely than men to make regular doctor visits.

The company found that the risks vary depending on the health problem. So the weight given to certain variables changes depending on whether the patient has asthma, high cholesterol, depression, diabetes or hypertension.

Various studies have shown that medication compliance improves when patients are reminded to take medications during visits to the doctor and through nurse phone calls. But most doctors and health insurance companies do not have the resources or money to check up on every patient, so the score allows them to take a targeted approach, checking in with phone calls and scheduling follow-up visits with patients at highest risk.

That's what happened to Bob Scott, 59, a former maintenance man and hospital orderly in Woonsocket, R.I., who takes nearly a dozen pills a day for heart and breathing problems. Mr. Scott had his first heart attack at 48, but admits he was not always vigilant about taking his medication.

"You follow what your doctor tells you at first, but then you start to feel better," Mr. Scott said. "Maybe you lose the fear of being sick, you feel better again and you have other priorities."

Mr. Scott said that about six months ago, his doctor met with him for a serious discussion about his health. "He more or less told me I was going to die," he said. "Now I'm very strict on taking my medicine, and I'm watching my diet. I respect my doctor — he's probably the only guy I trust with my life."

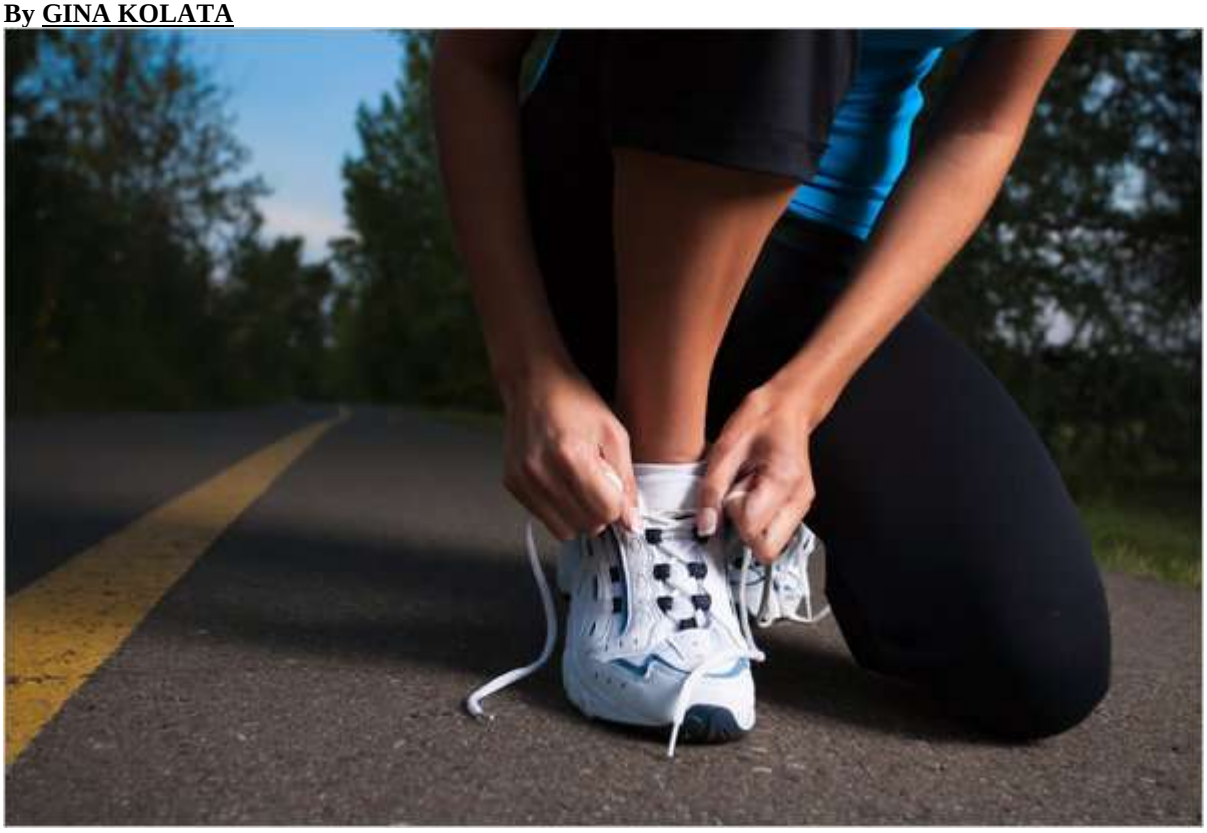
But many patients do not receive such strong messages from their doctors, or they simply fail to return for follow-up visits, said Rebecca Burkholder, vice president of health policy for the National Consumers League. The group in May started a three-year national campaign called Script Your Future (www.scriptyourfuture.org) aimed at improving medication compliance. Although the FICO medication adherence score has potential, the most important issue is raising awareness about why it's important to take medication as directed, Ms. Burkholder said.

"We view this as a public health problem," she said. "We really believe that encouraging that conversation between patient and professional can help them better understand their condition and the consequences of not taking their medicine."

http://well.blogs.nytimes.com/2011/06/20/keeping-score-on-how-you-take-your-medicine/?ref=health

When Running Up Mileage, 10 Percent Isn't the Cap

By GINA KOLATA



Chris Bernard

My friend Martin Strauss of Ann Arbor, Mich., was running 60 miles a week when he suffered a stress fracture that put him on crutches for three months. Now that he's better, he wants to play it safe to avoid another injury. But what's the best way to do that? How quickly can he ramp up the miles?

Martin decided to follow the 10 percent rule, one of the most widely known in running. It does not specify a starting distance but says you should increase your mileage no more than 10 percent a week. The idea is that this is a safe way to increase your distance without risking injury.

(Within limits, of course; if you started at 30 minutes a day and kept increasing 10 percent a week, after 41 weeks you'd be running 24 hours a day.)

Martin's first run was on March 15. He ran half a mile, on a treadmill. Over the next five weeks, he increased his distance to ten miles a week, then began using the ten percent rule. Last week he ran 22 miles, including a long run of 10 miles. He calculates that it will take him a total of 18 weeks from when he started his program to get back to running 60 miles a week.

I, like most runners, have heard of the rule and, like most, tried it once. But, like many, I did not stay with it. Another friend, Rafael Escandon of Philadelphia, tried it years ago when he was training for his first marathon. It was the slowest marathon he ever ran, slower even than one when he tore his calf muscle at mile 17 and somehow forced himself to finish the race, limping for the last 9 miles. Cliff Rosen, a distance runner in Maine, said he tried it once but "it didn't seem to work."

That made me wonder, Where did this rule come from?

Carl Foster, director of the Human Performance Laboratory at the University of Wisconsin in La Crosse, said its origin "is lost in history," and added, "Whether it is right is undocumented."

It might be more correct to say "almost undocumented." There is at least one large and rigorous study of the 10 percent rule, the sort of study that is a rarity in exercise science. Conducted by Dr. Ida Buist, Dr. Steef W. Bredeweg, Dr. Ron L. Diercks and their colleagues at the University of Groningen in the Netherlands, it's one of a continuing series of studies on how to prevent running injuries.

The injury problem is huge, said Dr. Diercks, head of the sports medicine program at the university — as many as 40 percent of runners are injured, usually to their feet, ankles, knees or legs. At his university's running clinics, 30 to 40 percent of beginning runners gave up because of injuries.

Although there are many training programs for beginning runners, none are based on good scientific evidence, Dr. Diercks said. He and his colleagues decided to conduct such a study.

They investigated the 10 percent rule because it is so popular and seemed to make sense with its gradual increase in effort. The study involved 532 novice runners whose average age was 40 and who wanted to train for a four-mile race held every year in the small town of Groningen.

Half the participants were assigned to a training program that increased their running time by 10 percent a week over 11 weeks, ending at 90 minutes a week. The others had an eight-week program that ended at 95 minutes a week. Everyone warmed up before each run by walking for five minutes. And everyone ran just three days a week.

And the results? The two groups had the same injury rate — about 1 in 5 runners.

Maybe, the investigators thought, they might prevent injuries with a conditioning program before the training started. So they did another clinical trial, randomly assigning one group of novice runners to a four-week program of walking, hopping and jumping rope before starting the running program. The others started right in with running.

The conditioning program had no effect. Once again, about 1 in 5 runners in both groups wound up with injuries.

The researchers are at a loss. Most people who take up running, Dr. Diercks says, think it will be easy — all they need is a pair of shoes. But in fact, running is a difficult sport, and most people quit before it becomes fun, often because they are injured. Experienced runners know how to adjust and return to the sport. Novices usually do not, he says.

Now the Groningen group wants to do a large and rigorous study of barefoot running, comparing it to running with shoes — another study that has never been done.

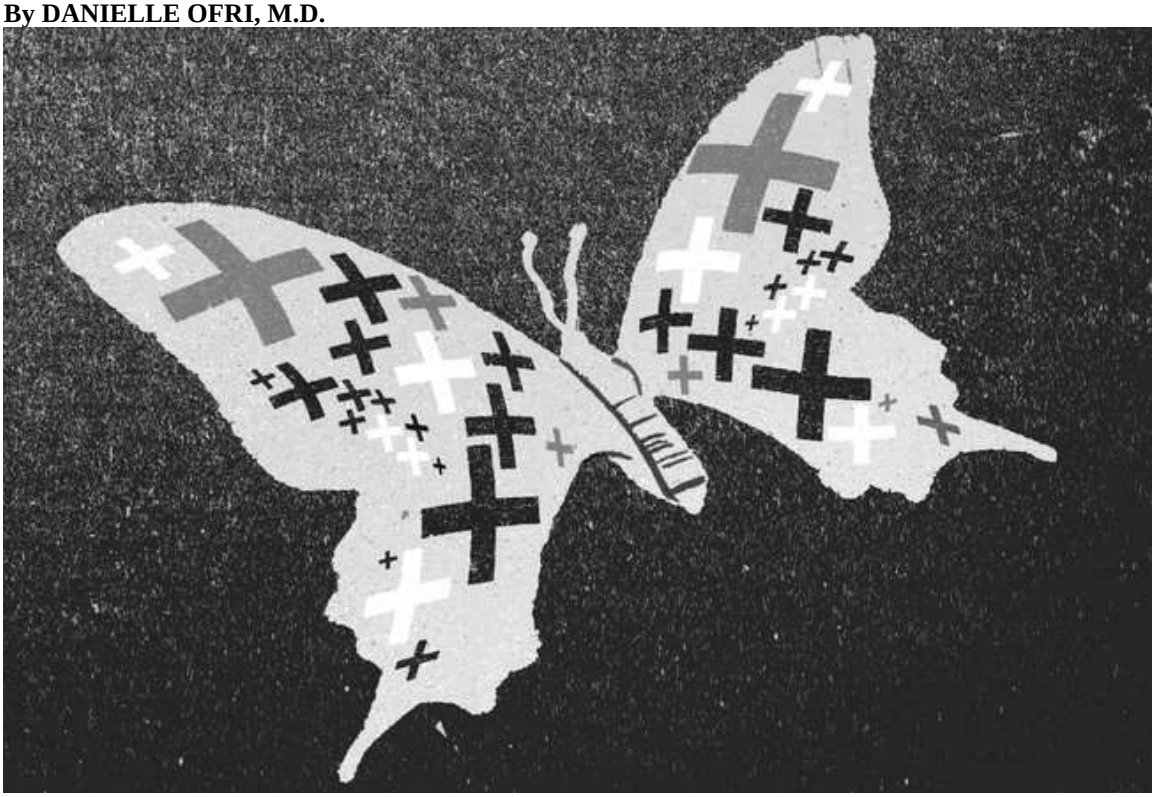
For now, though, the lesson is that running lore often is just that. And the 10 percent rule is a case in point. "Nobody found out if it works or what is the basis of it," Dr. Diercks said.

And that is the way it often goes in exercise science. People "hear something, they read something," he said, "and then it's like a religion."

http://www.nytimes.com/2011/06/21/health/nutrition/21best.html?ref=health

Stereotyping Patients, and Their Ailments

By DANIELLE OFRI, M.D.



When Mr. S. was doing time at Rikers Island in the early 1990s, he was given a standard battery of tests for the medical ailments that run rampant behind bars — AIDS, hepatitis, tuberculosis. He received the unwelcome news that he was H.I.V. positive, though his T-cell count was still in the normal range.

After his release from prison, he made his way to our hospital's H.I.V. clinic. He took his medications and showed up for his appointments, but he almost never got lab tests, since decades of drug use had obliterated his veins.

Despite the other medical assaults on his body — diabetes, hypertension, hepatitis C, stubborn leg ulcers — his immune system remained intact. About once a year, he'd allow his methadone doctor to draw blood from a ragged vein in his neck — practically the last vein to his name. His T-cell count stayed high enough to protect him from opportunistic infections. He seemed to be one of the rare, lucky "nonprogressors."

But after several years of consistently robust T-cell counts, one of the nurse practitioners had a hunch. She asked the methadone doctor not just for a T-cell count but also for a new H.I.V. test.

Lo and behold, it came back negative. The diagnosis had been wrong all along; the H.I.V. test at Rikers had been a false positive. He was promptly discharged from the H.I.V. clinic and sent to the general medical clinic, where I became his doctor.

Mr. S. has the craggy, almost grandfatherly look of someone who has retired from the drug-addled 1980s. His skin is corrugated from years of injecting. His tattoos have faded to a murky bluish gray. His voice is raspy but steady.

I wondered how the misdiagnosis could have persisted for so long — why we chose to explain his vigorous T-cells by classifying him as a nonprogressor, rather than considering that his initial H.I.V. test might have been incorrect.

Was it that we put too much faith in the test's "objectivity"? Or was it simply that Mr. S. fit the H.I.V. picture too well — Rikers prisoner, drug user, hepatitis C, tattoos — that we never imagined he could be negative?

When we first met, his calves were filleted open from knee to ankle with ulcers in various states of disrepair. He handed me a pagelong list of supplies he needed for the ulcers — saline bottles, gauze wraps, surgical tape, iodine, Silvadene cream, latex gloves, occlusive dressings — and I admit I was a little taken aback. I'd never seen a "druggie" — even an ex-druggie — so organized.

He didn't fit the picture.

Amazingly, over the years, thanks to his assiduous care, the ulcers gradually healed until there were only thin snaking scars on his calves to mark their sites.

He didn't fit the picture.

One day, after two decades of taking methadone at an impressively high dose, he abruptly tapered himself off. "I've had enough," he told me bluntly.

He didn't fit the picture.

When I asked him how he felt about the misdiagnosis of H.I.V., he simply shrugged: "It is what it is." Perhaps, given all the other things he'd suffered in his life, eight years of carrying a false diagnosis wasn't the worst thing.

But it made me think about the assumptions that medical professionals — and society in general — make about those who seem to fit a certain picture.

Over the years, Mr. S. shattered myth after myth. But in reality, he didn't *do* anything; he simply was who he was. It was society that had to shatter its myths: If we'd observed the conflicting data more carefully in the beginning, if we'd examined our own biases before being so positive in our judgment, he would have been spared this brush with H.I.V. — the stigma, the costly and unnecessary medical care, the drugs and their side effects.

Ultimately, he bequeathed me this lesson about my profession's penchant for stereotypes and snap judgments. I just wish he hadn't had to suffer all those years to convey it.

Dr. Danielle Ofri is an internist in New York City. Her newest book is "Medicine in Translation: Journeys With My Patients."

http://www.nytimes.com/2011/06/21/health/views/21cases.html?ref=health

Teens and Stress

Decisions and stress and adolescents, oh my!
Stressing out about a boyfriend or girlfriend or history test is part of a typical day for a teenager. But what is making these insignificant events seem like the end of the world?
With help from the National Science Foundation (NSF), Adriana Galván, a psychologist at the University of California, Los Angeles (UCLA), has been studying the effects of stress on teenagers and adults.
"Teenagers experience stress as more stressful," says Galván, "and if that stress is interfering with their decision making, it's really important to understand the neural mechanism that's underlying this connection between high levels of stress and poor decision making."
Galván's ground-breaking study focuses on the effect stress has on brain function. Study participants report their stress level daily, using a one to seven scale--seven being the worst. If participants rate their day as a seven, Galván will ask them to visit the lab for tests.
Nilufer Rustomji, an 18-year-old participant of the study, rates her day's stress level as a seven. Monitoring her brain function with Magnetic Resonance Imaging (MRI), Galván asks Rustomji to play a simple "reward and risk" video game, which involves wagering money.
"During the game, Rustomji is evaluating risk," explains Galván, "and while she's doing that evaluation, we are taking pictures of the brain to see how the brain makes [such] risky choices."
After computer processing the images, Galván analyzes how stress and risk influence what she calls the "reward system."
"The teenagers show more activation in the reward system than adults when making risky choices, and they are also making more risky choices than adults are," says Galván.
The prefrontal cortex is the part of the brain that helps regulate behavior but in adolescents, this region is not fully developed.
To help lower teens' stress, Galván says teens should double check and think about how the consequences will affect them later. "When you are stressed out as a teenager, it's interfering with your ability to make decisions," says Galván. "It's interfering with how the brain functions in regions that are still developing, mainly the reward system and the prefrontal cortex."
Galván's study is helping to provide deeper insight into why teenagers often act the way they do.
Miles O'Brien, Science Nation Correspondent
Jon Baime, Science Nation Producer

http://www.nsf.gov/news/special_reports/science_nation/teensstress.jsp?WT.mc_id=USNSF_51

Emotion Affects Memory's Reliability

Negative events remembered with less accuracy

Emotion-driven false memories could directly impact court cases, researchers say.

Credit and Larger Version

June 28, 2010

This is your memory. This is your memory on emotion.

Does emotion distort children's memories? Cornell University researchers Chuck Brainerd and Valerie Reyna say yes, and they say emotion-driven distortions or falsifications could directly impact court cases, affecting decisions made by prosecutors, judges and juries about the reliability of child witnesses.

"Emotion is so central to memory in the law," said Brainerd, professor of human development and an adjunct law professor at Cornell. "Determining the conditions in which false memories increase or can be suppressed or eliminated is an urgent question."

In a recent research study, Brainerd and Reyna found that emotion appears to distort both children's and adults' memories, especially when events have a negative emotional charge, such as those associated with crimes. They also found that children are less susceptible to false memories resulting from negative events, but that as a person grows older he or she is more susceptible.

The co-authors report their findings online this week in the *Journal of Experimental Child Psychology*. The research is supported by the National Science Foundation.

Leading memory theories claim that adults remember negative events better than children and have fewer false memories resulting from them. The law also assumes the validity of these theories. But Brainerd and Reyna's data show these ideas are not necessarily accurate.

Experiments conducted at Cornell's Memory and Neuroscience Laboratory show that experiences that excite negative emotions are very bad for the accuracy of children's memories and worse for adults. When an experience has negative emotional qualities, true memory levels are lowest and false memory levels are highest.

The researchers tested children, ages seven and 11, and young adults, ages 18-23, by exposing them to mild levels of emotion using a series of word lists. Specifically, they were exposed to closely-related emotional words such as pain, cut, ouch, cry, injury and so on. But with each list, certain related words were missing such as "hurt."

When asked to recognize words from the list, respondents would mistakenly remember "hurt" as one of the words. These mistakes allowed researchers to determine the level of emotion-induced false memory at each age.

"Our experiments allowed the distortive effects of emotion on children's memory to be studied ethically," said Reyna. "To avoid concerns about exposing children to levels of emotional intensity associated with crimes or other everyday events, our design exposed children, adolescents and adults to mild levels of emotion with word lists."

"The study showed that the ability of negative-arousing events to stimulate false memories increases considerably between early childhood and young adulthood," added Brainerd. "This is remarkable because common-sense and most theories of development expect that if emotion distorts memory, children ought to be more susceptible."

Brainerd and Reyna predicted the results based on their previous memory studies involving something called fuzzy trace theory. Fuzzy trace theory argues that children depend more heavily on a part of the mind that records, "what actually happened," while adults depend more on another part of the mind that records, "the meaning of what happened." It appears that meaning and emotion are connected to memory in ways not anticipated by memory theorists before now.

"We need to jettison the old idea that experiences that are negative and arousing are less prone to distortion than other types of events," said Brainerd. "We also need to jettison the related idea that children are more susceptible to memory distortion from negative experiences. Instead, the message is the opposite: negative-arousing events are probably more memory distorting, especially for adults."

-NSF-

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http://www.nsf.gov/news/news_summ.jsp?cntn_id=117140

Brain scans show disturbance in normal levels of empathy
November 7, 2008

Brain scans of young, aggressive bullies suggest they may actually enjoy seeing others in pain, according to a new University of Chicago study.

Functional Magnetic Resonance Imaging (fMRI) scans of eight 16- to 18-year-old boys with aggressive conduct disorder and eight matched adolescents without conduct disorder led researchers to this new hypothesis. The study showed increased activity in an area of the brain associated with rewards when the aggressive boys watched a video clip of someone inflicting pain on another person. The control group did not have the same response.The results are reported in the current issue of the journal *Biological Psychology*. The National Science Foundation supported the work.

"This is the first time that fMRI scans have been used to study situations that could otherwise provoke empathy," said lead researcher Jean Decety, professor in psychology and psychiatry at the University of Chicago.Decety and his colleagues released a study earlier this year in which fMRI scans showed 7- to 12-year-olds are naturally empathetic toward people in pain. The new research showed that this natural empathetic impulse may be disrupted in ways that increase aggression in some young people who are prone to bullying and other aggressive behaviors.

"Aggressive adolescents showed a specific and very strong activation of the amygdala and ventral striatum (an area that responds to feeling rewarded) when watching pain inflicted on others, which suggested that they enjoyed watching pain," Decety said. The youth were shown video clips in which people suffered pain accidentally, such as when a heavy bowl unintentionally was dropped on their hands, and intentionally, such as when a person stepped on another's foot.

Researchers expected the test subjects to be emotionally cold to the events, but instead they registered a high level of arousal. More research is needed to determine whether the reactions indicated enjoyment at seeing others in pain.

"This work will help us better understand ways to work with juveniles inclined to aggression and violence," Decety said. Researchers anticipate the study will help identify strategies for dealing with young people who are at risk of growing up to be antisocial or even psychopathic.

Although researchers point out more research is needed to begin developing strategies, they have some initial ideas regarding where to look for solutions. Benjamin Lahey, professor of epidemiology and psychiatry at the University of Chicago, who co-authored the paper with Decety, says finding ways to help these at risk youngsters self-regulate their emotions might be one place to start. But he acknowledges past difficulties with the approach.

A system of non-punitive punishments for aggressive behavior and rewards for non-aggressive behavior may be another approach. "The possible difficulty in this approach is the need to find ways that compensate for the fact that aggression might be self-reinforcing in these aggressive youths," said Lahey. "But at this point we don't have enough information to draw strong conclusions. Implications for treatment largely will depend on what we find in our next study."

Decety's and Lahey's work was assisted by University of Chicago students Kalina Michaslska and Yuko Akitsuki.

-NSF-

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http://www.nsf.gov/news/news_summ.jsp?cntn_id=112582

Stretching Old Material Yields New Results for Energy- and Environment-related Devices

June 21, 2011

Researchers at Virginia Tech in Blacksburg, Va. recently found a way to improve electricity generating fuel cells, potentially making them more efficient, powerful and less expensive. Specifically, they discovered a way to speed up the flow and filtering of water or ions, which are necessary for fuel cells to operate.

Simply put, the researchers stretched Nafion, a polymer electrolyte membrane, or PEM, commonly used in fuel cells and increased the speed at which it selectively filters substances from ions and water.

The resulting process could be important to a number of energy and environment-related applications such as any of several industrial processes that involve filtering, including improving batteries in cars, water desalination and even the production of artificial muscles for robots.

The journal *Nature Materials* published the results in its June 19 issue in the article, "Linear coupling of alignment with transport in a polymer electrolyte membrane," by Jing Li, Jong Keun Park, Robert B. Moore and Louis A. Madsen, all with the chemistry department in the College of Science and the Macromolecules and Interfaces Institute at Virginia Tech.

"I got the idea for some of these experiments after I saw Bob Moore give a talk at the University of North Carolina about Nafion when I was a post-doc there working with liquid crystals," said Madsen, an assistant professor of physical, polymer and materials chemistry who led the study.

In order to improve PEMs, Madsen and Virginia Tech Chemistry Professor Robert Moore studied exactly how water moves through Nafion at the molecular level and measured how changes in the structure of the material affected water flow. They found stretching it caused channels in the PEM material to align in the direction of the stretch, allowing water to flow through faster.

"Stretching drastically influences the degree of alignment," said Madsen. "So the molecules move faster along the direction of the stretch, and in a very predictable way. These materials actually share some properties with liquid crystals--molecules that line up with each other and are used in every LCD television, projector and screen."

"This is a very clever approach which demonstrates the advantages of interdisciplinary materials research and which may offer important benefits to both energy technologies and sustainability of our natural resources," said Andy Lovinger, polymers program director in the National Science Foundation's Division of Materials Research, which funded the study.

Nafion was discovered in the 1960's and is made up of molecules that combine the non-stick and tough nature of Teflon with the conductive properties of an acid. It is one of many PEMs used to filter water and ions that the researchers say could benefit from the stretching process.

-NSF-

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http://www.nsf.gov/news/news_summ.jsp?cntn_id=119875&org=NSF&from=news

Fastest Sea-Level Rise in Two Millennia Linked to Increasing Global Temperatures

Rate is greater now than at any time during past 2,100 years
June 20, 2011

The rate of sea level rise along the U.S. Atlantic coast is greater now than at any time in the past 2,000 years--and has shown a consistent link between changes in global mean surface temperature and sea level.

The findings are published this week in the journal *Proceedings of the National Academy of Sciences (PNAS)*.

The research, funded by the National Science Foundation (NSF), was conducted by Andrew Kemp, Yale University; Benjamin Horton, University of Pennsylvania; Jeffrey Donnelly, Woods Hole Oceanographic Institution; Michael Mann, Pennsylvania State University; Martin Vermeer, Aalto University School of Engineering, Finland; and Stefan Rahmstorf, Potsdam Institute for Climate Impact Research, Germany.

"Having a detailed picture of rates of sea level change over the past two millennia provides an important context for understanding current and potential future changes," says Paul Cutler, program director in NSF's Division of Earth Sciences.

"It's especially valuable for anticipating the evolution of coastal systems," he says, "in which more than half the world's population now lives."

Adds Kemp, "Scenarios of future rise are dependent on understanding the response of sea level to climate changes. Accurate estimates of past sea-level variability provide a context for such projections."

Kemp and colleagues developed the first continuous sea-level reconstruction for the past 2,000 years, and compared variations in global temperature to changes in sea level over that time period.

The team found that sea level was relatively stable from 200 BC to 1,000 AD.

Then in the 11th century, sea level rose by about half a millimeter each year for 400 years, linked with a warm climate period known as the Medieval Climate Anomaly.

Then there was a second period of stable sea level during a cooler period called the Little Ice Age. It persisted until the late 19th century.

Since the late 19th century, sea level has risen by more than 2 millimeters per year on average, the steepest rate for more than 2,100 years.

"Sea-level rise is a potentially disastrous outcome of climate change," says Horton, "as rising temperatures melt land-based ice, and warm ocean waters."

To reconstruct sea level, the scientists used microfossils called foraminifera preserved in sediment cores extracted from coastal salt marshes in North Carolina. The age of the cores was estimated using radiocarbon dating and other techniques.

To test the validity of their approach, the team compared its reconstructions with tide-gauge measurements from North Carolina for the past 80 years, and global tide-gauge records for the past 300 years.

A second reconstruction from Massachusetts confirmed their findings.

The records were corrected for contributions to sea-level rise made by vertical land movements.

The reconstructed changes in sea level over the past millennium are consistent with past global temperatures, the researchers say, and can be determined using a model relating the rate of sea level rise to global temperature.

"Data from the past helped calibrate our model, and will improve sea level rise projections under scenarios of future temperature increases," says Rahmstorf.

Support for the research also was provided by the National Oceanic and Atmospheric Administration, United States Geological Survey, the Academy of Finland, the European Science Foundation through European Cooperation in Science and Technology and the University of Pennsylvania.

-NSF-

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http://www.nsf.gov/news/news_summ.jsp?cntn_id=119841&org=NSF&from=news

Atmospheric carbon dioxide buildup unlikely to spark abrupt climate change

By Vince Stricherz
News and Information

There have been instances in Earth history when average temperatures have changed rapidly, as much as 10 degrees Celsius (18 degrees Fahrenheit) over a few decades, and some have speculated the same could happen again as the atmosphere becomes overloaded with carbon dioxide.

New research lends support to evidence from numerous recent studies that suggest abrupt climate change appears to be the result of alterations in ocean circulation uniquely associated with ice ages.

"There might be other mechanisms by which greenhouse gases may cause an abrupt climate change, but we know of no such mechanism from the geological record," said David Battisti, a University of Washington atmospheric sciences professor.

Battisti was part of a team that used a numerical climate model coupled with an oxygen-isotope model to determine what caused climate shifts in a computer-generated episode that mimicked Heinrich events during the last ice age, from 110,000 to 10,000 years ago. Heinrich events produced huge numbers of North Atlantic Ocean icebergs that had broken off from glaciers.

The simulations showed the sudden increase in North Atlantic sea ice cooled the Northern Hemisphere, including the surface of the Indian Ocean, which reduced rainfall over India and weakened the Indian monsoon.

Battisti noted that while carbon dioxide-induced climate change is unlikely to be abrupt, the impacts of changing climate could be.

"When you lose a keystone species, ecosystems can change very rapidly," he said. "Smoothly retreating sea ice will cause fast warming if you live within a thousand kilometers of the ice. If warming slowly dries already semi-arid places, fires are going to be more likely."

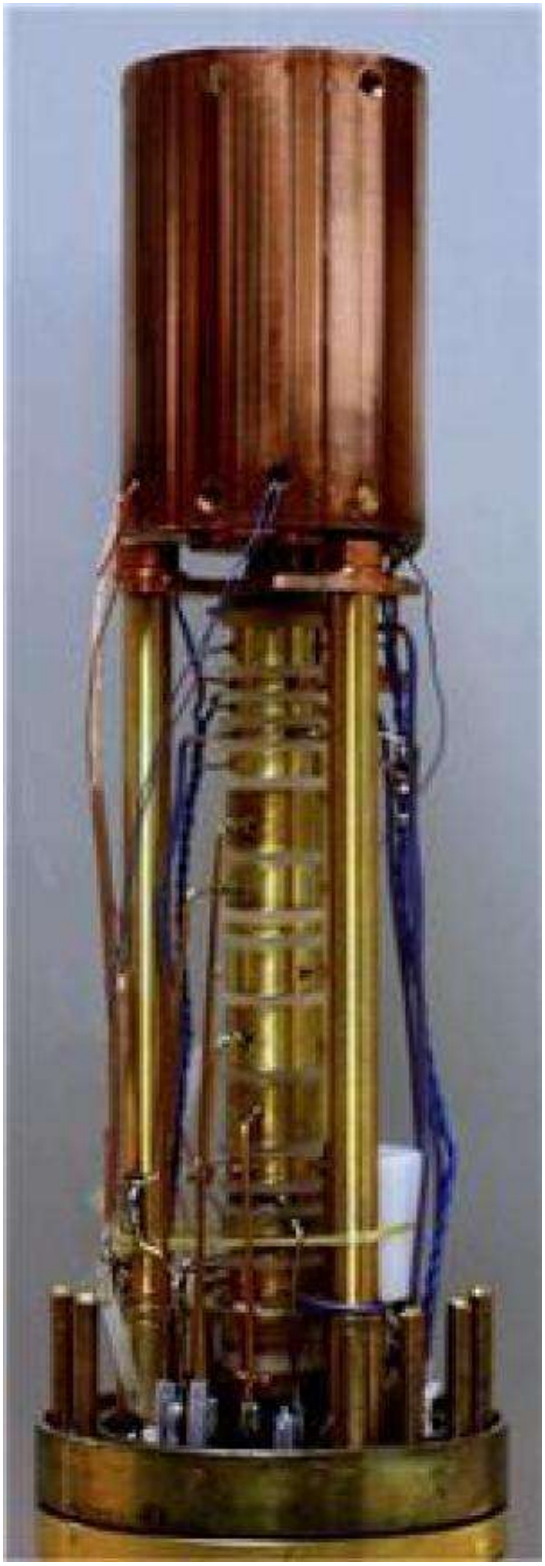
Previous studies of carbonate deposits from caves in China and India are believed to show the intensity of monsoon precipitation through the ratio of specific oxygen isotopes. The modeling the scientists' used in the current study reproduced those isotope ratios, and they determined that the Heinrich events were associated with changes in the intensity of monsoon rainfall in India rather than East Asia.

The research is published online June 19 by Nature Geoscience. The lead author is Franceso Pausata of the Bjerknes Centre for Climate Research in Norway. Besides Battisti, other co-authors are Kerim Nisancioglu of UNI Research in Norway and Cecilia Bitz of the UW.

The work was funded by the Norwegian Research Council and the U.S. National Science Foundation.

http://www.washington.edu/news/articles/atmospheric-carbon-dioxide-buildup-unlikely-to-spark-abrupt-climate-change

Quantum Leap: Magnetic Properties of a Single Proton Directly Observed for the First Time



Double-Penning trap for the storage of one individual proton and the detection of spin quantum-jumps. (Credit: © Holger Kracke)

ScienceDaily (June 21, 2011) — An important milestone in the direct measurement of the magnetic moment of the proton and its anti-particle has been achieved. Researchers at Johannes Gutenberg University Mainz (JGU) and the Helmholtz Institute Mainz (HIM), together with their colleagues from the Max Planck Institute for Nuclear Physics in Heidelberg and the GSI Helmholtz Center for Heavy Ion Research in Darmstadt, have observed spin quantum-jumps with a single trapped proton for the first time. The result is a pioneering step forward in the endeavor to directly measure the magnetic properties of the proton with high precision. The measuring principle is based on the observation of a single proton stored in an electromagnetic particle trap. As it would also be possible to observe an anti-proton using the same method, the prospect that an explanation for the matter-antimatter imbalance in the universe could be found has become a reality. It is essential to be able to analyze antimatter in detail if we are to understand why matter and antimatter did not completely cancel each other out after the Big Bang - in other words, if we are to comprehend how the universe actually came into existence.

The proton has an intrinsic angular momentum or spin, just like other particles. It is like a tiny bar magnet; in this analogy, a spin quantum jump would correspond to a (switch) flip of the magnetic poles. However, detecting the proton spin is a major challenge. While the magnetic moments of the electron and its anti-particle, the positron, were already being measured and compared in the 1980s, this has yet to be achieved in the case of the proton. "We have long been aware of the magnetic moment of the proton, but it has thus far not been observed directly for a single proton but only in the case of particle ensembles," explains Stefan Ulmer, a member of the work group headed by Professor Dr Jochen Walz at the Institute of Physics at the new Helmholtz Institute Mainz.

The real problem is that the magnetic moment of the proton is 660 times smaller than that of the electron, which means that it is considerably harder to detect. It has taken the collaborative research team five years to prepare an experiment that would be precise enough to pass the crucial test. "At last we have successfully demonstrated the detection of the spin direction of a single trapped proton," says an exultant Ulmer, a stipendiary of the International Max Planck Research School for Quantum Dynamics in Heidelberg.

This opens the way for direct high-precision measurements

of the magnetic moments of both the proton and the anti-proton. The latter is likely to be undertaken at CERN, the European laboratory for particle physics in Geneva, or at FLAIR/GSI in Darmstadt. The magnetic moment of the anti-proton is currently only known to three decimal places. The method used at the laboratories in Mainz aims at a millionfold improvement of the measuring accuracy and should represent a new highly sensitive test of the matter-antimatter symmetry. This first observation of the spin quantum jumps of a single proton is a crucial milestone in the pursuit of this aim.
Matter-antimatter symmetry is one of the pillars of the Standard Model of elementary particle physics. According to this model, particles and anti-particles should behave identically once inversions of charge, parity and time - referred to as CPT transformation – are applied simultaneously. High-precision comparisons of the fundamental properties of particles and anti-particles make it possible to accurately determine whether this symmetrical behavior actually occurs, and may provide the basis for theories that extend beyond the Standard Model. Assuming that a difference between the magnetic moments of protons and anti-protons could be detected, this would open up a window on this "new physics".
The results obtained by the Mainz cooperative research team were published online in the journal *Physical Review Letters*. The article is presented as an "Editor's Suggestion." Furthermore, the American Physical Society (APS) presents the article as "Viewpoint."
The research work carried out by the team of Professor Dr Jochen Walz on anti-hydrogen and the magnetic moment of protons forms part of the "Precision Physics, Fundamental Interactions and Structure of Matter" (PRISMA) Cluster of Excellence, which is currently applying for future sponsorship under the German Federal Excellence Initiative.

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

Journal Reference:

1. S. Ulmer, C. Rodegheri, K. Blaum, H. Kracke, A. Mooser, W. Quint, J. Walz. **Observation of Spin Flips with a Single Trapped Proton**. *Physical Review Letters*, 2011; 106 (25) DOI: 10.1103/PhysRevLett.106.253001

http://www.sciencedaily.com/releases/2011/06/110621101329.htm

Earliest Art in the Americas: Ice Age Image of Mammoth or Mastodon Found in Florida

The engraving, approximately 13,000 years old, is 3 inches long from the top of the head to the tip of the tail, and 1.75 inches tall from the top of the head to the bottom of the right foreleg. (Credit: Chip Clark/Smithsonian)

ScienceDaily (June 21, 2011) — Researchers from the Smithsonian Institution and the University of Florida have announced the discovery of a bone fragment, approximately 13,000 years old, in Florida with an incised image of a mammoth or mastodon. This engraving is the oldest and only known example of Ice Age art to depict a proboscidean (the order of animals with trunks) in the Americas. The team's research is published online in the *Journal of Archaeological Science*.

The bone was discovered in Vero Beach, Fla. by James Kennedy, an avocational fossil hunter, who collected the bone and later while cleaning the bone, discovered the engraving. Recognizing its potential importance, Kennedy contacted scientists at the University of Florida and the Smithsonian's Museum Conservation Institute and National Museum of Natural History.

"This is an incredibly exciting discovery," said Dennis Stanford, anthropologist at the Smithsonian's National Museum of Natural History and co-author of this research. "There are hundreds of depictions of proboscideans on cave walls and carved into bones in Europe, but none from America -- until now."

The engraving is 3 inches long from the top of the head to the tip of the tail, and 1.75 inches tall from the top of the head to the bottom of the right foreleg. The fossil bone is a fragment from a long bone of a large mammal -- most likely either a mammoth or mastodon, or less likely a giant sloth. A precise identification was not possible because of the bone's fragmented condition and lack of diagnostic features.

"The results of this investigation are an excellent example of the value of interdisciplinary research and cooperation among scientists," said Barbara Purdy, professor emerita of anthropology at the University of Florida and lead author of the team's research. "There was considerable skepticism expressed about the authenticity of the incising on the bone until it was examined exhaustively by archaeologists, paleontologists, forensic anthropologists, materials science engineers and artists."

One of the main goals for the research team was to investigate the timing of the engraving -- was it ancient or was it recently engraved to mimic an example of prehistoric art? It was originally found near a location, known as the Old Vero Site, where human bones were found side-by-side with the bones of extinct Ice Age animals in an excavation from 1913 to 1916. The team examined the elemental composition of the engraved bone and others from the Old Vero Site. They also used optical and electron microscopy, which showed no discontinuity in coloration between the carved grooves and the surrounding material. This indicated that both surfaces aged simultaneously and that the edges of the carving were worn and showed no signs of being carved recently or that the grooves were made with metal tools.

Believed to be genuine, this rare specimen provides evidence that people living in the Americas during the last Ice Age created artistic images of the animals they hunted. The engraving is at least 13,000 years old as this is the date for the last appearance of these animals in eastern North America, and more recent Pre-Columbian people would not have seen a mammoth or mastodon to draw.

The team's research also further validates the findings of geologist Elias Howard Sellards at the Old Vero Site in the early 20th Century. His claims that people were in North America and hunted animals at Vero Beach during the last Ice Age have been disputed over the past 95 years.
A cast of the carved fossil bone is now part of an exhibit of Florida Mammoth and Mastodons at the Florida Museum of Natural History in Gainesville.

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

Journal Reference:

1. Barbara A. Purdy, Kevin S. Jones, John J. Mecholsky, Gerald Bourne, Richard C. Hulbert Jr., Bruce J. MacFadden, Krista L. Church, Michael W. Warren, Thomas F. Jorstad, Dennis J. Stanford, Melvin J. Wachowiak, Robert J. Speakman. **Earliest Art in the Americas: Incised Image of a Proboscidean on a Mineralized Extinct Animal Bone from Vero Beach, Florida**. *Journal of Archaeological Science*, 2 June 2011 DOI: 10.1016/j.jas.2011.05.022

http://www.sciencedaily.com/releases/2011/06/110621131334.htm

Oldest Eurasian Hominoids Lived in Swabia: Molar Tooth Dated at 17 Million Years Old

Photo of the 17-million-year-old molar tooth of the hominoid from Engelswies. (Credit: Böhme)

ScienceDaily (June 22, 2011) — Africa is regarded as the center of evolution of humans and their precursors. Yet long before modern humans left Africa some 125,000 years ago, their antecedents migrated from Africa to Eurasia many times, as is documented in the fossil record. How often, when and why hominoids went "out of Africa" is still a hotly debated field of intense research. Possibly, the first wave of emigration occurred 17 million years before the present, as documented by finds in the Swabian northern Alpine foreland basin, southwest of Sigmaringen.

Researchers from Tübingen successfully pinpointed the age of a molar tooth at 17 to 17.1 Ma, together with colleagues from Helsinki, Munich and Stuttgart. It is thus the oldest known Eurasian hominoid found to date. The results are now published in the *Journal of Human Evolution*. The owner of the tooth once inhabited a lakeside landscape with subtropical vegetation in a warm-humid climatic zone. Today, there is an abandoned quarry at the locality known among palaeontologists for its fossiliferous layers.

Prof. Dr. Madelaine Böhme of the Senckenberg Center for Human Evolution and Palaeoecology (HEP) at the Tübingen University combined different methods of dating of the rocks in which the molar tooth was found. Housed at the Stuttgart State Museum of Natural History, the find itself dates to June 24, 1973. It was discovered by the founder and then-director of the Geological-Palaeontological Institute in Mainz, Prof. Dr. Heinz Tobien, in the "Talsberg" quarry in Engelswies, Inzigkofen. Only in 2001 was the molar taken under scrutiny and determined as a hominoid fossil, albeit with some insecurity regarding its age.

The dating of fossils usually requires a combination of methods. For relative dating, rapid evolutionary progress of fauna accompanying the find can be taken into account, as for example fossil teeth of the rodent *Megacricetodon bavaricus*. The researchers in Böhme's group also utilized the fact that in the past, Earth's magnetic poles displayed inversions at regular intervals. The magnetic polarity can be recorded in sediments, which can then be dated by the methods of magnetostratigraphy.

Böhme and colleagues completed the first magnetostratigraphic calibration of the Engelswies locality. Absolute age determination was achieved by referencing the data to the acknowledged "Astronomical Tuned Neogene Time Scale" (ATNTS04). The researchers ascertained inverse polarity of Earth's magnetic field for the time during the sedimentation of a 5m thick layer above and below the bed in which the hominoid molar tooth was found. Thus, the bed can be dated with relative precision at 17 to 17.1 Ma.

Böhme, who also heads the lab of terrestrial palaeoclimatology at the University of Tübingen, used further fossils for a reconstruction of the vegetation and climate of the area during the time of deposition. Thus, the mean yearly temperature was approximately 20 °C in the area of what is now Southern Germany, some 11 °C above today's conditions. Winters were frost-free. There was a swamp to the south of the lake, full of reed beds and a coast line of trees, palm trees (amongst them the climbing rattan palms), lianas, ferns and grasses. To the north was a slope covered by an evergreen forest. This vegetation is unique in the circum-Alpine area.

Possibly, this exceptional situation was the result of regional peculiarities at a time of rather fast climate change.
As the authors write, "The chronologic relationships support the idea that the Engelswies hominoid was a descendent of Early Miocene Afro-Arabian afropithecins." This find is thus the earliest known trace of hominoids which immigrated to Eurasia from Africa. "The significant gap between the Engelswies hominoid and later European kenyapithecines as well as paleoclimatic considerations lead us to speculate that this early out of Africa migration end up in a dead end" African hominoids (Kenyapithecines) came to Eurasia again perhaps merely 14 Million years ago, and then evolved into the first large hominids (e.g. Orang Utan)."

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

Journal Reference:

1. Madelaine Böhme, Hayfaa Abdul Aziz, Jerome Prieto, Valerian Bachtadse, Günter Schweigert. **Bio-magnetostratigraphy and environment of the oldest Eurasian hominoid from the Early Miocene of Engelswies (Germany)**. *Journal of Human Evolution*, 2011; DOI: 10.1016/j.jhevol.2011.04.012

http://www.sciencedaily.com/releases/2011/06/110622072744.htm

Cutting Edge Training Developed the Human Brain 80,000 Years Ago

Cave in South Africa where excavations have taken place. (Credit: Image courtesy of Lund University)

ScienceDaily (June 22, 2011) — Advanced crafting of stone spearheads contributed to the development of new ways of human thinking and behaving, according to new findings by archaeologists from Lund University. The technology took a long time to acquire, required step by step planning and increased social interaction across the generations. This led to the human brain developing new abilities.

Some 200,000 years ago, small groups of people wandered across Africa, looking anatomically much like present-day humans, but not thinking the way we do today. Studies of fossils and the rate of mutations in DNA show that the human species to which we all belong -- *Homo sapiens sapiens* -- has existed for 200,000 years.

But the archaeological research of recent years has shown that, even though the most ancient traces of modern humans are 200,000 years old, the development of modern cognitive behaviour is probably much younger. For about 100,000 years, there were people who looked like us, but who were cognitively and socially very different from us.

It is precisely that period of transformation that the researchers at Lund University in Sweden have studied. In the next issue of the *Journal of Human Evolution*, they present new findings on the early modern humans that existed in what is now South Africa, approximately 80,000 years ago.

The findings show that people at that time used advanced technology for the production of spearheads and that the complicated crafting process likely developed the working memory and social life of humans.

"When the technology was passed from one generation to the next, from adults to children, it became part of a cultural learning process which created a socially more advanced society than before. This affected the development of the human brain and cognitive ability," says Anders Högberg, PhD.

The technology led to increased social interaction within and across the generations. This happened because the crafting of stone spearheads took a long time to learn and required a lot of knowledge, both theoretical and practical. Producing a stone spearhead also required the ability to plan in several stages. This social learning contributed to the subsequent development of early modern humans' cognitive ability to express symbolism and abstract thoughts through their material culture, for example in the form of decorated objects.

"The excavations have been carried out in a small cave; the location we have studied is called Hollow Rock Shelter and lies 250 km north of Cape Town. We are cooperating with the University of Cape Town and the research we have just published is part of a larger research project on this location," says Professor Lars Larsson.

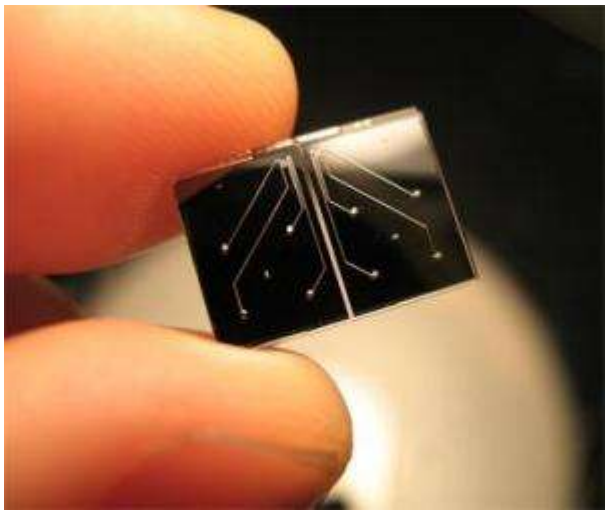
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Lund University**.

Journal Reference:

1. Anders Högberg, Lars Larsson. **Lithic technology and behavioural modernity: New results from the Still Bay site, Hollow Rock Shelter, Western Cape Province, South Africa**. *Journal of Human Evolution*, 2011; DOI: 10.1016/j.jhevol.2011.02.006

http://www.sciencedaily.com/releases/2011/06/110621093308.htm

How Dense Is a Cell? Combining Ancient Principle With New Technology, Researchers Devise New Way to Answer Question



MIT researchers designed this tiny microfluidic chip that can measure the mass and density of single cells. (Credit: Photo courtesy of the Manalis Lab)

ScienceDaily (June 22, 2011) — More than 2,000 years after Archimedes found a way to determine the density of a king's crown by measuring its mass in fluids, MIT scientists have used a similar principle to solve an equally vexing puzzle -- how to measure the density of a single cell.

"Density is such a fundamental, basic property of everything," says William Grover, a research associate in MIT's Department of Biological Engineering. "Every cell in your body has a density, and if you can measure it accurately enough, it opens a whole new window on the biology of that cell."

The new method, described in the *Proceedings of the National Academy of Sciences* the week of June 20, involves measuring the buoyant mass of each cell in two fluids of different densities. Just as measuring the crown's density helped Archimedes determine whether it was made of pure gold, measuring cell density could allow researchers to gain biophysical insight into fundamental cellular processes such as adaptations for survival, and might also be useful for identifying diseased cells, according to the authors.

Grover and recent MIT PhD recipient Andrea Bryan are lead authors of the paper. Both work in the lab of Scott Manalis, a professor of biological engineering, member of the David H. Koch Institute for Integrative Cancer Research and senior author of the paper.

Going with the flow

Measuring the density of living cells is tricky because it requires a tool that can weigh cells in their native fluid environment, to keep them alive, and a method to measure each cell in two different fluids.

In 2007, Manalis and his students developed the first technique to measure the buoyant mass of single living cells. Their device, known as a suspended microchannel resonator, pumps cells, in fluid, through a microchannel that runs across a tiny silicon cantilever, or diving-board structure. That cantilever vibrates within a vacuum; when a cell flows through the channel, the frequency of the cantilever's vibration changes. The cell's buoyant mass can be calculated from the change in frequency.

To adapt the system to measure density, the researchers needed to flow each cell through the channel twice, each time in a different fluid. A cell's buoyant mass (its mass as it floats in fluid) depends on its absolute mass and volume, so by measuring two different buoyant masses for a cell, its mass, volume and density can be calculated.

The new device rapidly exchanges the fluids in the channel without harming the cell, and the entire measurement process for one cell takes as little as five seconds.

David Weitz, professor of physics at Harvard University, says the new technique is a clever way of measuring cell density, and opens up many new avenues of research. "The very interesting thing they show is that density seems to have a more sensitive change than some of the more standard measurements. Why is that? I don't know. But the fact that I don't know means it's interesting," he says.

Changes in density

The researchers tested their system with several types of cells, including red blood cells and leukemia cells. In the leukemia study, the researchers treated the cells with an antibiotic called staurosporine, then measured their density less than an hour later. Even in that short time, a change in density was already apparent. (The cells grew denser as they started to die.) The treated leukemia cells increased their density by only about 1 percent, a change that would be difficult to detect without a highly sensitive device such as this one. Because of that rapid response and sensitivity, this method could become a good way to screen potential cancer drugs. "It was really easy, by the density measurement, to identify cells that had responded to the drug. If we had looked at mass alone, or volume alone, we never would have seen that effect," Bryan says.

The researchers also demonstrated that malaria-infected red blood cells lose density as their infection progresses. This density loss was already known, but this is the first time it has been observed in single cells. Being able to detect changes in red-blood-cell density could also offer a new way to test athletes who try to cheat by "doping" their blood -- that is, by removing their own blood and storing it until just before their competition, when it is transfused back into the bloodstream. This boosts the number of red blood cells, potentially enhancing athletic performance.

Storing blood can alter the blood's physical characteristics, and if those include changes in density, this technique may be able to detect blood doping, Grover says.

Researchers in Manalis' lab are now investigating the densities of other types of cells, and are starting to work on measuring single cells as they grow over time -- specifically cancer cells, which are characterized by uncontrolled growth.

"Understanding how density of individual cancer cells relates to malignant progression could provide fundamental insights into the underlying cellular processes, as well as lead to clinical strategies for treating patients in situations where molecular markers don't yet exist or are difficult to measure due to limited sample volumes," Manalis says.

Other authors on the paper are MIT research scientist Monica Diez-Silva; Subra Suresh, former dean of the MIT School of Engineering; and John Higgins of Massachusetts General Hospital and Harvard Medical School.

Story Source:

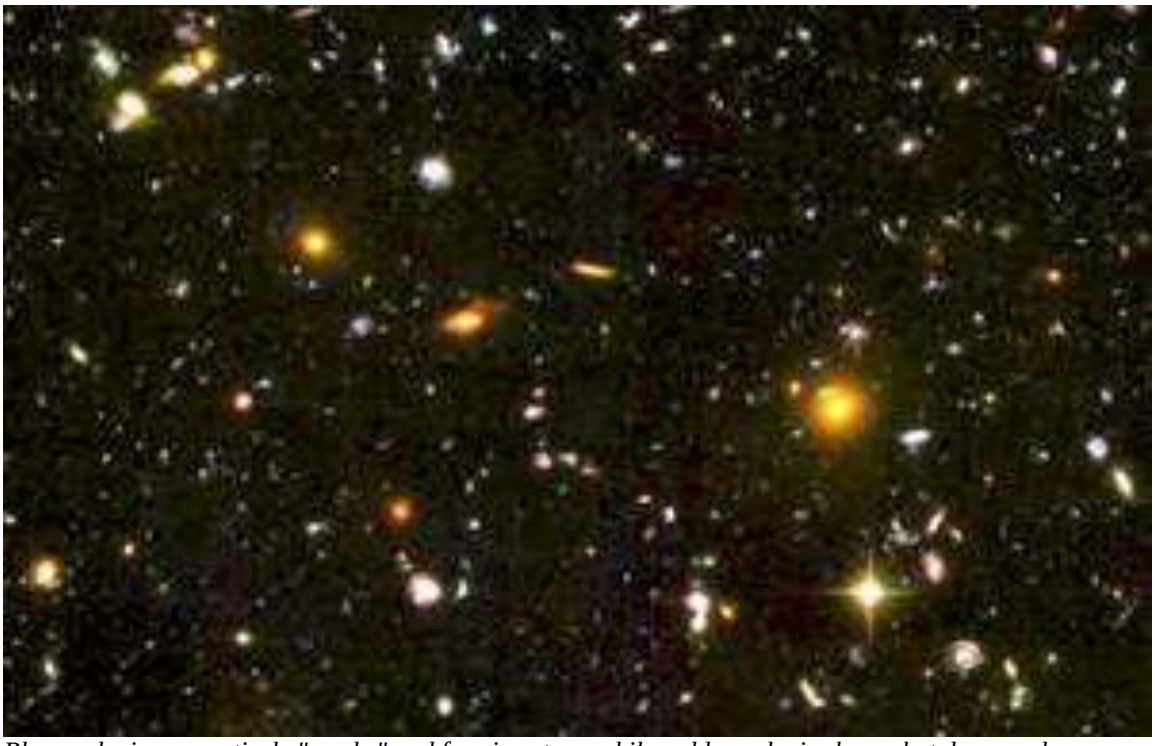
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Massachusetts Institute of Technology**. The original article was written by MIT News Office.

Journal Reference:

1. W. H. Grover, A. K. Bryan, M. Diez-Silva, S. Suresh, J. M. Higgins, S. R. Manalis. **Measuring single-cell density**. *Proceedings of the National Academy of Sciences*, 2011; DOI: 10.1073/pnas.1104651108

http://www.sciencedaily.com/releases/2011/06/110621114312.htm

Astronomers Discover That Galaxies Are Either Asleep or Awake



Bluer galaxies are actively "awake" and forming stars, while redder galaxies have shut down and are "asleep." (Credit: NASA, ESA, S. Beckwith (STScI) and the HUDF team)

ScienceDaily (June 22, 2011) — Astronomers have probed into the distant universe and discovered that galaxies display one of two distinct behaviors: they are either awake or asleep, actively forming stars or are not forming any new stars at all.

Scientists have known for several years that galaxies in the nearby universe seem to fall into one of these two states. But a new survey of the distant universe shows that even very young galaxies as far away as 12 billion light years are either awake or asleep as well, meaning galaxies have behaved this way for more than 85 percent of the history of the universe. (Looking at galaxies farther away is like looking back in time when they were much younger, because of how long it takes the light they emit to reach us here on Earth.)

"The fact that we see such young galaxies in the distant universe that have already shut off is remarkable," said Kate Whitaker, a Yale University graduate student and lead author of the paper, which is published in the June 20 online edition of the Astrophysical Journal.

In order to determine whether the galaxies were asleep or awake, Whitaker and her colleagues fabricated a new set of filters, each one sensitive to different wavelengths of light, which they used on a 4-meter Kitt Peak telescope in Arizona. They spent 75 nights peering into the distant universe and collecting light from 40,000 galaxies ranging in distance from the nearby universe out to 12 billion light years away. The resulting survey is the deepest and most complete ever made at those distances and wavelengths of light.

The team deciphered the galaxies' dual behavior based on the color of the light they emit. Because of the physics of star formation, active, wakeful galaxies appear bluer, while the light emitted by passive, sleepy galaxies tends toward the redder end of the spectrum.

The researchers found that there are many more active galaxies than passive ones, which agrees with the current thinking that galaxies start out actively forming stars before eventually shutting down.

"We don't see many galaxies in the in-between state," said Pieter van Dokkum, a Yale astronomer and another author of the paper. "This discovery shows how quickly galaxies go from one state to the other, from actively forming stars to shutting off."

Whether the sleeping galaxies have completely shut down remains an open question, Whitaker said. However, the new study suggests the active galaxies are forming stars at rates about 50 times greater than their sleepy counterparts.
"Next, we hope to determine whether galaxies go back and forth between waking and sleeping or whether they fall asleep and never wake up again," van Dokkum said. "We're also interested in how long it takes galaxies to fall asleep, and whether we can catch one in the act of dozing off."
Other authors of the study include Ivo Labbé (Leiden University and Carnegie Observatories); Gabriel Brammer (Yale University and European Southern Observatory); Mariska Kriek (Princeton University and Harvard-Smithsonian Center for Astrophysics); Danilo Marchesini (Tufts University); Ryan Quadri and Marijn Franx (Leiden University); Adam Muzzin, Rachel Bezanson, Kyoung-Soo Lee, Britt Lundgren, Erica Nelson, Tomer Tal and David Wake (Yale University); Rik Williams (Carnegie Observatories); Garth Illingworth (UCO/Lick Observatory); and Gregory Rudnick (University of Kansas).

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

Journal Reference:

1. Katherine E. Whitaker, Ivo Labbe, Pieter G. van Dokkum, Gabriel Brammer, Mariska Kriek, Danilo Marchesini, Ryan F. Quadri, Marijn Franx, Adam Muzzin, Rik J. Williams, Rachel Bezanson, Garth D. Illingworth, Kyoung-Soo Lee, Britt Lundgren, Erica J. Nelson, Gregory Rudnick, Tomer Tal, David A. Wake. **The NEWFIRM Medium-band Survey: Photometric Catalogs, Redshifts and the Bimodal Color Distribution of Galaxies out to z~3**. *The Astrophysical Journal*, 2011 [link]

http://www.sciencedaily.com/releases/2011/06/110621101135.htm

Multiple Ocean Stresses Threaten 'Globally Significant' Marine Extinction, Experts Warn

A new report warns that the world's ocean is at high risk of entering a phase of extinction of marine species unprecedented in human history. (Credit: © piboon / Fotolia)

ScienceDaily (June 21, 2011) — An international panel of marine experts warns in a new report that the world's ocean is at high risk of entering a phase of extinction of marine species unprecedented in human history.

The preliminary report arises from the first ever interdisciplinary international workshop to consider the cumulative impact of all stressors affecting the ocean. Considering the latest research across all areas of marine science, the workshop examined the combined effects of pollution, acidification, ocean warming, overfishing and hypoxia (deoxygenation).

The scientific panel concluded that:

- The combination of stressors on the ocean is creating the conditions associated with every previous major extinction of species in Earth's history.
- The speed and rate of degeneration in the ocean is far faster than anyone has predicted.
- Many of the negative impacts previously identified are greater than the worst predictions.
- Although difficult to assess because of the unprecedented speed of change, the first steps to globally significant extinction may have begun with a rise in the extinction threat to marine species such as reef-forming corals.

Dr Alex Rogers, Scientific Director of the International Programme on the State of the Ocean (IPSO) which convened the workshop said: "The findings are shocking. As we considered the cumulative effect of what humankind does to the ocean the implications became far worse than we had individually realized. This is a very serious situation demanding unequivocal action at every level. We are looking at consequences for humankind that will impact in our lifetime, and worse, our children's and generations beyond that."

Marine scientists from institutions around the world gathered at Oxford University under the auspices of IPSO and the International Union for Conservation of Nature (IUCN). The group reviewed recent research by world ocean experts and found firm evidence that the effects of climate change, coupled with other human--induced impacts such as over-- fishing and nutrient run-- off from farming, have already caused a dramatic decline in ocean health.

Increasing hypoxia (low oxygen levels) and anoxia (absence of oxygen, known as ocean dead zones) combined with warming of the ocean and acidification are the three factors which have been present in every mass extinction event in Earth's history.

There is strong scientific evidence that these three factors are combining in the ocean again, exacerbated by multiple severe stressors. The scientific panel concluded that a new extinction event was inevitable if the current trajectory of damage continues.

As examples, the panel point out:

- The rate at which carbon is being absorbed by the ocean is already far greater now than at the time of the last globally significant extinction of marine species, some 55 million years ago, when up to 50% of some groups of deep-sea animals were wiped out.
- A single mass coral bleaching event in 1998 killed 16% of all the world's tropical coral reefs.
- Overfishing has reduced some commercial fish stocks and populations of by-catch species by more than 90%.
- New science also suggests that pollutants including flame retardant chemicals and synthetic musks found in detergents are being traced in the Polar Seas, and that these chemicals can be absorbed by tiny plastic particles in the ocean which are in turn ingested by marine creatures.

The experts agreed that adding these and other threats together means that the ocean and the ecosystems within it are unable to recover, being constantly bombarded with multiple attacks.
The report sets out a series of recommendations and calls on states, regional bodies and the United Nations to enact measures to better conserve ocean ecosystems, and in particular demands the urgent adoption of better governance of the largely unprotected high seas which make up the majority of the world's ocean.
Dan Laffoley, Marine Chair of IUCN's World Commission on protected Areas and Senior Advisor on Marine Science and Conservation for IUCN, and co-- author of the report, said: "The world's leading experts on oceans are surprised by the rate and magnitude of changes we are seeing. The challenges for the future of the ocean are vast, but unlike previous generations we know what now needs to happen. The time to protect the blue heart of our planet is now, today and urgent."
The report's Executive Summary, entitled "International Earth System expert workshop on ocean impacts and stresses," as well as case studies on its main findings, images and AV soundbites, are available at: http://www.stateoftheocean.org/

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **The International Programme on the State of the Ocean**.

http://www.sciencedaily.com/releases/2011/06/110621101453.htm

Survival of the Weakest? Bacteria Develop Restraint for Survival in a Rock-Paper-Scissors Community

New research shows that in some structured communities, organisms increase their chances of survival if they evolve some level of restraint that allows competitors to survive as well, a sort of "survival of the weakest." The phenomenon was observed in a community of three "nontransitive" competitors, meaning their relationship to each other is circular as in the children's game rock-paper-scissors in which scissors always defeats paper, paper always defeats rock and rock always defeats scissors. In this case, the researchers created nontransitive communities of three strains of Escherichia coli bacteria, one that produces two antibiotics, one that is resistant to both antibiotics and one that is sensitive to both. (Credit: © Nikolai Sorokin / Fotolia)

ScienceDaily (June 21, 2011) — It is a common perception that bigger, stronger, faster organisms have a distinct advantage for long-term survival when competing with other organisms in a given community.

But new research from the University of Washington shows that in some structured communities, organisms increase their chances of survival if they evolve some level of restraint that allows competitors to survive as well, a sort of "survival of the weakest."

The phenomenon was observed in a community of three "nontransitive" competitors, meaning their relationship to each other is circular as in the children's game rock-paper-scissors in which scissors always defeats paper, paper always defeats rock and rock always defeats scissors.

In this case, the researchers created nontransitive communities of three strains of *Escherichia coli* bacteria, one that produces two antibiotics, one that is resistant to both antibiotics and one that is sensitive to both. The sensitive strain outgrows the resistant strain, which outgrows the producer, which kills the sensitive strain.

In communities in which the resistant strain curbed its pursuit of the producer, the resistant strain thrived. With no restraint, the resistant strain greatly reduced the population of the producer. But then the resistant strain was forced into greater competition with the strain sensitive to the antibiotics and the resistant strain's short-term gain meant its long-term demise.

"By becoming a better competitor in a well-mixed system, it could actually drive itself to extinction," said Joshua Nahum, a University of Washington graduate student in biology. "By growing faster, it actually can hurt its abundance."

Nahum is the lead author of a paper describing the work published online the week of June 22 in the *Proceedings of the National Academy of Sciences*. Co-authors are Brittany Harding, a UW biology undergraduate, and Benjamin Kerr, a UW associate professor of biology and the paper's corresponding author.

The researchers created 192 pools in which the bacteria could grow and interact. The bacteria could migrate among pools, and when migration occurred among neighboring pools the three strains formed multi-pool patches.

"The restrained patches, the ones that grew slower, seemed to last longer and the unrestrained patches, the ones that grew faster, burned themselves out faster," Nahum said.
To understand the process, imagine a community of three strains, Rock, Paper and Scissors, and then imagine the emergence of an unrestrained supercompetitor, Rock* (rock star), that is able to displace Scissors even faster than regular Rock can. But that also makes Rock* a better competitor against Rock, the researchers said. Eventually Rock* will be a victim of its own success, being preyed upon by Paper.
The irony, Kerr said, is that "by chasing your victim faster you actually help out the guy who's chasing you." Restraining exploitive behavior is beneficial to the patch in the long run, he said, and is a realistic embodiment of the proverb "The enemy of my enemy is my friend."
"In patches with faster growth, members of the unrestrained patch burn through their victims and then are left to face their victims' victims, their own enemies," he said.
The observed effect only applies to structured communities with limited migration, the researchers said. In an unstructured community with greater migration and mixing, a species that curbed its aggressiveness would not reduce its chances of being engulfed by its enemy.
The findings have potential implications for other ecological systems, including mating systems of certain lizards that could have analogs among some reptiles, fish, birds and insects.
The work was funded by the National Institutes of Health and the National Science Foundation.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Washington**. The original article was written by Vince Stricherz.

Journal Reference:

1. Joshua R. Nahum, Brittany N. Harding and Benjamin Kerr. **In the Light of Evolution V: Cooperation Sackler Colloquium: Evolution of restraint in a structured rock–paper–scissors community**. *PNAS*, June 20, 2011 DOI: 10.1073/pnas.1100296108

http://www.sciencedaily.com/releases/2011/06/110620161304.htm

Can Humans Sense Earth's Magnetism? Human Retina Protein Can Function as Light-Sensitive Magnetic Sensor

For migratory birds, the ability to sense Earth's magnetic field is crucial to navigating the long-distance voyages these animals undertake during migration. Humans, however, are widely assumed not to have an innate magnetic sense. (Credit: © Shopartgallery.com / Fotolia)

ScienceDaily (June 21, 2011) — For migratory birds and sea turtles, the ability to sense Earth's magnetic field is crucial to navigating the long-distance voyages these animals undertake during migration. Humans, however, are widely assumed not to have an innate magnetic sense. Research published in *Nature Communications* this week by faculty at the University of Massachusetts Medical School shows that a protein expressed in the human retina can sense magnetic fields when implanted into *Drosophila*, reopening an area of sensory biology in humans for further exploration.

In many migratory animals, the light-sensitive chemical reactions involving the flavoprotein cryptochrome (CRY) are thought to play an important role in the ability to sense Earth's magnetic field. In the case of *Drosophila*, previous studies from the Reppert laboratory have shown that the cryptochrome protein found in these flies can function as a light-dependent magnetic sensor.

To test whether the human cryptochrome 2 protein (hCRY2) has a similar magnetic sensory ability, Steven Reppert, MD, the Higgins Family Professor of Neuroscience and chair and professor of neurobiology, graduate student Lauren Foley, and Robert Gegear, PhD, a post doctoral fellow in the Reppert lab now an assistant professor of biology and biotechnology at Worcester Polytechnic Institute, created a transgenic *Drosophila* model lacking its native cryptochrome protein but expressing hCRY2 instead. Using a behavioral system Reppert's group previously developed, they showed that these transgenic flies were able to sense and respond to an electric-coil-generated magnetic field and do so in a light-dependent manner.

These findings demonstrate that hCRY2 has the molecular capability to function in a magnetic sensing system and may pave the way for further investigation into human magnetoreception. "Additional research on magneto sensitivity in humans at the behavioral level, with particular emphasis on the influence of magnetic field on visual function, rather than non-visual navigation, would be informative," wrote Reppert and his colleagues in the study.

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

Journal Reference:

1. Lauren E. Foley, Robert J. Gegear, Steven M. Reppert. **Human cryptochrome exhibits light-dependent magnetosensitivity**. *Nature Communications*, 2011; 2: 356 DOI: 10.1038/ncomms1364

http://www.sciencedaily.com/releases/2011/06/110621121319.htm

Corporal Punishment: Mothers' Self-Recorded Audio Gives Unique Real-Time View of Spanking

Believed to be the first study of its kind, 37 mothers recorded up to 36 hours of interactions with their children. The data capture the moments before, during and after punishment, which ranged from spanking with a belt to admonishments while hitting. (Credit: Image courtesy of Southern Methodist University)

ScienceDaily (June 22, 2011) — In a new corporal punishment study based on actual audio recordings, mothers spank, slap or hit their young children, sparking crying, tantrums and whimpering. Believed to be the first study of its kind, 37 mothers recorded up to 36 hours of interactions with their children, says psychologist George W. Holden, Southern Methodist University, Dallas. The data capture the moments before, during and after punishment, which ranged from spanking with a belt to admonishments while hitting. In one recording, a mom spanks her 3-year-old 11 times for fighting with his sister. In another, a mom slaps her son for turning the page of a book while she reads to him. In still another, a mom spanks her 5-year-old when he refuses to clean up his room after repeated warnings to do so.

Those are examples of the corporal punishment captured by a study of 37 families in which mothers voluntarily recorded their evening interactions with their young children over the course of six days, say the study's researchers.

The audio recordings, believed to be the first of their kind, provide real-time data captured before, during and after mothers disciplined their children with spanking or slapping, said psychologist and parenting expert George W. Holden at Southern Methodist University, Dallas.

The unique recordings capture from 12 hours to 36 hours of data from each mother, mainly the daily ordinary activities such as fixing supper and bathing children, said Holden, lead researcher on the study.

But occasionally conflict erupts, sometimes followed by corporal punishment.

The data go to the heart of the long-running debate over whether parents should spank their children.

"In the case where the child was slapped for grabbing a book, it was not 10 seconds later he did it again," said Holden. "The amazing thing is, the mom was reading so nicely to the child and the child was being so normal, reaching for the book or wanting to turn the page or point to something."

Believed to be first audio data of naturally occurring spanking

With its "event-sampling" approach, the research is a unique opportunity to understand what's going on in the life of a family before spanking, including whether conflict gradually escalates or instead blows up out of nowhere, Holden said. It also reveals what occurs with spanking, such as verbal reprimands, admonitions, yelling or time-out.

"Despite the fact there have been hundreds of studies on spanking, I think with these audio recordings we have the first data of naturally occurring spanking," said Holden, who has published five books and more than 55 scientific papers on parenting and child development.
"Virtually all previous studies have relied on verbal reports, either asking parents how often they spank, and a few asking children how they felt about being spanked," he said. "This study is not affected or biased by memory or attitudes or orientations toward discipline because it's what's happening in the home."
The research, "Investigating Actual Incidents of Spanking in the Home," was presented June 3-4 at the international conference "Global Summit on Ending Corporal Punishment and Promoting Positive Discipline" in Dallas.
Holden, a professor in the SMU Department of Psychology, was a conference organizer and is an advocate of positive alternatives to spanking as cited in his psychology textbook "Parenting: A Dynamic Perspective" (Sage Publications Inc., 2010).

Chaotic interactions indicate parents didn't alter practices

Participants in the study included families of various ethnicities, ranging from affluent to middle income to poor, said Paul Williamson, a researcher on the study. Acts of corporal punishment also varied, from spanking with a belt to admonishing children while hitting, said Williamson, an SMU psychology doctoral student.
"One interaction in particular, a child of 2 or 3 years of age had either been hitting or kicking her mother, and in response the mother either spanks the child or slaps the child on the hand and says, 'That'll teach you not to hit your mother,'" Williamson said. "We've captured interactions with families that are very chaotic. Some of them are actually quite difficult to listen to. That tells us, at least for some families, they're not inhibiting or suppressing the kinds of parenting practices they use."

Spanking and negative unintended consequences

Researchers invited mothers to participate in the study through fliers distributed at day-care centers, said Williamson. Mothers were informed of the study's purpose to look at parent-child interactions. The mothers agreed to wear the audio recording devices each evening for up to six days.
"We're finding a wide range of reactions to the spanking," Holden said. "Some children don't appear to react, whereas the majority react with crying, some tantruming and some whimpering that can go from just a few seconds, to our longest is about 75 seconds."
Parents didn't shy from talking with the researchers about spanking and their belief that it's effective and necessary discipline, the researchers said.
"So many parents believe in the technique and are not defensive about their use of it," Holden said. "They erroneously believe it's a useful technique to raise well-behaved kids."

Spanking widespread globally, despite harm to children

From 70 percent to 90 percent of parents spank their children, and it's practiced in the vast majority of countries worldwide, Holden said. Studies have shown that its single positive effect is immediate compliance. Increasingly, however, the evidence is clear that spanking is associated with many unintended negative consequences, he said.
"Children who are spanked are more likely to be aggressive toward other children and adults," Holden said. "Over the long term they tend to be more difficult and noncompliant, have various behavior problems, can develop anxiety disorders or depression, and later develop antisocial behavior. They are more at risk to be involved in intimate partner violence, and they are at risk to become child abusers."
The discipline also can escalate, Holden said.
"We know that the majority of physical child abuses cases actually begin with a disciplinary encounter that then gets out of control," he said. "So for that reason alone, it's not a good idea to use corporal punishment."
The researchers hope their study ultimately will help parents use positive discipline and less punishment, he said.
"It's not the once or twice a year that a child may be swatted, but it's the kids who are exposed to frequent corporal punishment -- that is the concern," Holden said. "Kids need discipline, but centered on mutual respect and love, without potentially harming the child with corporal punishment."
Besides Holden and Williamson, other researchers included Grant Holland, SMU psychology graduate student, and Rose Dunn, an SMU psychology department graduate. The study was funded by Timberlawn Psychiatric Research Foundation in Dallas.

The "Global Summit on Ending Corporal Punishment and Promoting Positive Discipline" was sponsored by Southern Methodist University, the Center for Effective Discipline, the Center for Children and Families, the Child Rights Information Network, the Global Initiative to End Corporal Punishment of Children, the Family Violence & Sexual Assault Institute, and the Institute on Violence, Abuse and Trauma.

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

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Teeming With Life, Pacific's California Current Likened to Africa's Serengeti Plain

Tail of the whale. This blue whale was encountered during a tagging expedition by the Oregon State University Marine Mammal Institute in 2006 near the Channel Islands of California. (Credit: Craig Hayslip, courtesy of OSU Marine Mammal Institute)

ScienceDaily (June 22, 2011) — Like the vast African plains, two huge expanses of the North Pacific Ocean are major corridors of life, attracting an array of marine predators in predictable seasonal patterns, according to final results from the Census of Marine Life Tagging of Pacific Predators (TOPP) project published June 22 in the journal *Nature*.

The paper culminates the TOPP program's decade-long effort to track top marine predator movements in the Pacific Ocean. It presents for the first time the results for all 23 tagged species and reveals how migrations and habitat preferences overlap -- a remarkable picture of critical marine life pathways and habitats.

The study found that major hot spots for large marine predators are the California Current, which flows south along the US west coast, and a trans-oceanic migration highway called the North Pacific Transition Zone, which connects the western and eastern Pacific on the boundary between cold sub-arctic water and warmer subtropical water -- about halfway between Hawaii and Alaska.

"These are the oceanic areas where food is most abundant, and it's driven by high primary productivity at the base of the food chain -- these areas are the savanna grasslands of the sea," say co-authors and project originators Barbara Block of Stanford University's Hopkins Marine Station and Daniel Costa, professor of ecology and evolutionary biology at the University of California, Santa Cruz.

"Knowing where and when species overlap is valuable information for efforts to manage and protect critical species and ecosystems."

Drs. Costa and Block were joined by Steven Bograd of the NOAA Southwest Fisheries Science Center, Randy Kochevar of Stanford University and others to launch the project in 2000 as part of the Census of Marine Life, a 10-year research initiative that investigated the diversity, distribution, and abundance of marine life in the global ocean. TOPP became the world's largest-ever biologging study, eventually involving more than 75 biologists, oceanographers, engineers and computer scientists across five countries.

Says Dr. Block: "It's been a bit like looking down on the African savanna and trying to figure out: Where are the watering holes that a zebra and a cheetah might use? Where are the fertile valleys? Where are the deserts that animals avoid, and the migratory corridors that animals such as wildebeest use to travel from place to place? We've come to a vast oceanic realm in the Pacific and answered these questions for animals as diverse as bluefin tuna, blue whales and leatherback sea turtles."

"This is the first publication that pulls all of the pieces together in one place," says Dr. Costa, who oversaw the tracking of marine mammals, birds, and turtles. "We brought together a large team of investigators to study diverse species and look at how these organisms use the ocean. It is an unprecedented examination of so many species over such a large scale."

The scientists used a variety of technologies to track the locations of different species as well as environmental variables such as water temperature, salinity, and depth. Altogether, the project deployed 4,306 electronic tags on the 23 species, yielding a huge amount of data for analysis.

Working with Census scientists at Dalhousie University in Halifax, Canada and its Future of Marine Animal Populations project (FMAP), the scientists spent two years synthesizing data sets with advanced statistical techniques and discerned intersecting hotspots and highways of ocean life and how marine conditions influenced where animals hang out.

"One of the challenges for this study was to take distinctly different types of location data -- some very precise from ARGOS satellites and others far less precise from ambient light level readings and bring them together using a powerful statistical framework that enabled identification of high use areas" says Dalhousie's Dr. Ian Jonsen.

The results suggest water temperature is key to the seasonal migrations of many species. This was particularly evident in the large marine ecosystem defined by the California Current, where cool, nutrient-rich water moves south along the US west coast.

The study reveals the Current as a vast marine savanna to and within which a large number of whales, sharks, seals, seabirds, turtles and tunas migrate loyaly every year.

It shows many highly migratory marine species return to the same ocean regions, homing with astonishing fidelity to the places they were first tagged, following a predictable seasonal pattern.

Says Dr. Block: "For me, the homing capacity of species which routinely return to the California Current or shelf waters of North America has been the biggest surprise."

Adds Dr. Costa: "It is akin to a student from London studying in far-off Rome and returning home each summer at the same moment -- but doing it all in the dark, without a map or compass, using only their internal sense of position and direction."

According to the authors, the mechanisms and cues that allow species to home with such fidelity to seasonal pathways are not yet fully understood, "but may represent a capacity to discriminate among areas of seasonal significance for foraging or reproduction."

Some predators, such as California sea lions, spend their whole lives within the California Current, but others migrate vast distances across the Pacific Ocean to reach its abundant prey such as krill, sardines, anchovies, and squid.

"How or why a young bluefin tuna less than two years of age wakes up in the light of the Japan sea and decides to swim to Baja remains completely unknown," says Dr. Block. "Once they get here, tagging data indicate they reside for years, taking advantage of the rich forage off North American coastlines. These tunas become vulnerable to oceanic fisheries across the Pacific during both this highly migratory period and this retentive period lunching on our coast."

The project found several species, including leatherback sea turtles, black-footed albatrosses, sooty shearwaters, bluefin tunas and salmon sharks) migrate more than 2,000 km from the western, central or south Pacific basin to reach the California Current's rich food resources -- a commute equal to that between Seattle and San Diego.

Species making seasonal north-south migrations included bluefin tunas and yellowfin tunas; mako, white and salmon sharks; blue whales; male elephant seals; and leatherback sea turtles.

Other species moved between near-shore and offshore waters, residing within the California Current or the Gulf of Alaska for a while, then migrating to points that ranged into the North Pacific transition zone (female elephant seals, salmon sharks and Laysan albatrosses), the subtropical gyre and north equatorial current (blue and mako sharks and leatherback sea turtles), or the 'café' regions of the eastern Pacific and the Hawaiian Islands (where species like white sharks, albacore tunas, and black-footed albatrosses meet).

Says Dr. Bograd of NOAA: "In the California Current we see a great deal of coastal upwelling, especially during the late spring and summer. This is when cold, nutrient-rich water rises to the ocean surface, causing phytoplankton blooms and creating a rich food source for a variety of ocean animals."

The researchers found that the ocean productivity from upwelling was also associated with the north/south migratory patterns exhibited by several species. For the first time the TOPP team has been able to link the movements of tunas, sharks and blue whales north and south along the southwestern US coastline with seasonal changes in temperature and chlorophyll concentrations.

"Using satellite observations of temperature and chlorophyll concentrations alone, we can now predict when and where individual species are likely to be in a given ocean region and begin to understand factors that control their movements. This is fundamental to the concept of ecosystem-based management," says Dr. Costa.

The researchers also used distinctly different types of tracking data to examine the partitioning of habitats by closely related species. Different tuna species, for example, prefer particular water temperatures, and these preferences correlate with physiological differences between the species.
In addition to developing new tracking technologies and techniques, the researchers had to manage large datasets and synthesize different kinds of data for the final analyses.
In addition to Drs. Block, Costa, Bograd and Jonsen, the paper was co-authored by

- Arliss Winship, and Greg Breed of Dalhousie University;
- Salvador Jorgensen, George Shillinger, James Ganong, Alan Swithenbank, and Mike Castleton of Stanford University;
- Scott Shaffer of San Jose State University;
- Elliott Hazen, Dave Foley, Heidi Dewar, and Scott Benson of the NOAA Southwest Fisheries Science Center;
- Autumn-Lynn Harrison, Michael Weise, and Bill Henry of University of California Santa Cruz;
- Bruce Mate of Oregon State University; and
- Kurt Schaefer of the Inter-American Tropical Tuna Commission.

Says Dr. Block: "We clearly have an amazing African-like game park in our waters off the west coast. It will take enormous vision to protect this wild place. I hope our study stimulates the discussion of how best to do this."
"Without effective management of open ocean realms, the bluefin tuna, leatherback sea turtles, blue whales and white sharks seen in the central and eastern Pacific or off our North American shores in 2011 might not be there for future generations. This work has created an opportunity to protect this marine wilderness and keep North American waters teeming with predators."
TOPP and FMAP were two of 17 projects of the Census of Marine Life, which concluded last October -- an ambitious 10-year, 80-nation endeavor to assess and explain the diversity and abundance of life in the oceans.
Funding for this study was provided as part of the synthesis activities of the Census of Marine Life.
TOPP was funded by the Alfred P. Sloan Foundation, the David and Lucile Packard Foundation, and the Gordon and Betty Moore Foundation, with additional support from the Office of Naval Research, NOAA, the Marine Life JIP-OPG, and the Monterey Bay Aquarium Foundation.
Funding for FMAP was provided by the Sloan Foundation.

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

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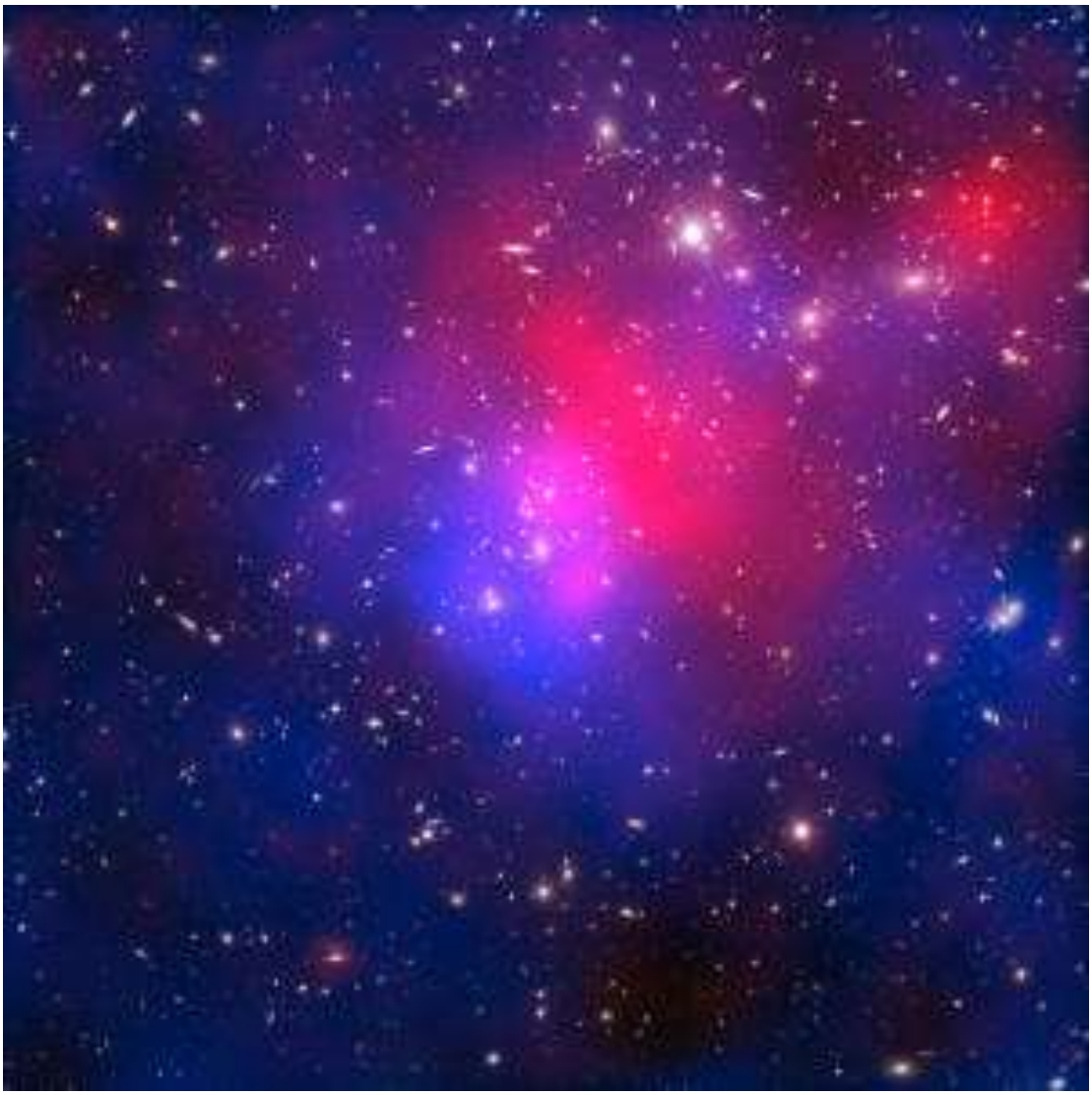
http://www.sciencedaily.com/releases/2011/06/110622135211.htm

Pandora's Cluster: A Galactic Crash Investigation



This image combines visible light exposures of galaxy cluster Abell 2744 taken by the NASA/ESA Hubble Space Telescope and the European Southern Observatory's Very Large Telescope, with X-ray data from NASA's Chandra X-ray Observatory and a mathematical reconstruction of the location of dark matter. The galaxies in the cluster, while they are the only part that is visible in the optical part of the spectrum, actually only provide around 5 percent of the mass in the cluster. Hot intracluster gas (shown in pink) is visible through its X-ray emissions, observed by NASA's Chandra satellite. The blue overlay shows a map of the mass in the cluster. This is reconstructed based on detailed analysis of the way that the cluster bends light from galaxies in the distant background. Evidence of this light bending can be seen in arc-like distortions in parts of this image. Since dark matter makes up the lion's share of mass in the cluster -- around 75 percent -- this blue overlay reveals the location of the otherwise invisible dark matter. Analysis of this data has allowed scientists to observe some strange phenomena in Abell 2744, including a pocket of dark matter with no gas or galaxies, and a clump of galaxies with no associated gas. Astronomers believe that Abell 2744 formed from the simultaneous pile-up of at least four separate clusters. (Credit: NASA, ESA, ESO, CXC, and D. Coe (STScI)/J. Merten (Heidelberg/Bologna))

ScienceDaily (June 22, 2011) — When huge clusters of galaxies crash together, the resulting mess is a treasure trove of information for astronomers. By investigating one of the most complex and unusual colliding clusters in the sky, an international team of astronomers has pieced together the history of a cosmic crash that took place over a period of 350 million years.

Julian Merten, one of the lead scientists for this new study [1] of cluster Abell 2744, explains: "Like a crash investigator piecing together the cause of an accident, we can use observations of these cosmic pile-ups to reconstruct events that happened over a period of hundreds of millions of years. This can reveal how structures form in the Universe, and how different types of matter interact with each other when they are smashed together."

"We nicknamed it Pandora's Cluster because so many different and strange phenomena were unleashed by the collision. Some of these phenomena had never been seen before," adds Renato Dupke, another member of the team.

Abell 2744 has now been studied in more detail than ever before by combining data from the NASA/ESA Hubble Space Telescope, ESO's Very Large Telescope (VLT), the Japanese Subaru telescope and NASA's Chandra X-Ray Observatory.

The galaxies in the cluster are clearly visible in the Hubble and VLT images. Although the galaxies are bright they make up less than 5% of the mass there. The rest is gas (around 20%), which is so hot that it shines only in X-rays, and dark matter (around 75%), which is completely invisible. To understand what was going on in the collision the team needed to map the positions of all three types of matter in Abell 2744.

Dark matter is particularly elusive as it does not emit, absorb or reflect light (hence its name), but only makes itself apparent through its gravitational attraction. To pinpoint the location of this mysterious substance the team exploited a phenomenon known as gravitational lensing. This is the bending of light rays from distant galaxies as they pass through the gravitational field present in the cluster. The result is a series of telltale distortions in the images of galaxies in the background of the Hubble and VLT observations. By carefully plotting the way that these images are distorted, it is possible to map quite accurately where the mass -- and hence the dark matter -- actually lies.

By comparison, finding the hot gas in the cluster is simpler as NASA's Chandra X-ray Observatory can observe it directly. These observations are not just crucial to find out where the gas is, but also to show the angles and speeds at which different components of the cluster came together.

When the astronomers looked at the results they found many curious features. "Abell 2744 seems to have formed from four different clusters involved in a series of collisions over a period of some 350 million years. The complicated and uneven distribution of the different types of matter is extremely unusual and fascinating," says Dan Coe, the other lead author of the study.

It seems that the complex collision has separated out some of the hot gas and dark matter so that they now lie apart from each other, and from the visible galaxies. Pandora's Cluster combines several phenomena that have only ever been seen singly in other systems.

Near the core of the cluster is a "bullet," where the gas of one cluster collided with that of another to create a shock wave. The dark matter passed through the collision unaffected [2].

In another part of the cluster there seem to be galaxies and dark matter, but no hot gas. The gas may have been stripped away during the collision, leaving behind no more than a faint trail.

Even odder features lie in the outer parts of the cluster. One region contains lots of dark matter, but no luminous galaxies or hot gas. A separate ghostly clump of gas has been ejected, which precedes rather than follows the associated dark matter. This puzzling arrangement may be telling astronomers something about how dark matter behaves and how the various ingredients of the Universe interact with each other.

Galaxy clusters are the biggest structures in the cosmos, containing literally trillions of stars. The way they form and develop through repeated collisions has profound implications for our understanding of the Universe. Further studies of the Pandora's Cluster, the most complex and fascinating merger yet found, are in progress.

The Hubble Space Telescope is a project of international cooperation between ESA and NASA.

Notes:

[1] This study appears in a paper entitled "Creation of cosmic structure in the complex galaxy cluster merger Abell 2744," to be published in the *Monthly Notices of the Royal Astronomical Society*. The international team of astronomers consists of J. Merten (Institute for Theoretical Astrophysics, Heidelberg, Germany;

INAF-Osservatorio Astronomico di Bologna, Italy), D. Coe (Space Telescope Science Institute, Baltimore, USA), R. Dupke (University of Michigan, USA; Eureka Scientific, USA; National Observatory, Rio de Janeiro, Brazil), R. Massey (University of Edinburgh, Scotland), A. Zitrin (Tel Aviv University, Israel), E.S. Cypriano (University of Sao Paulo, Brazil), N. Okabe (Academia Sinica Institute of Astronomy and Astrophysics, Taiwan), B. Frye (University of San Francisco, USA), F. Braglia (University of British Columbia, Canada), Y. Jimenez-Teja (Instituto de Astrofisica de Andalucia, Granada, Spain), N. Benitez (Instituto de Astrofisica de Andalucia), T. Broadhurst (University of Basque Country, Spain), J. Rhodes (JPL/Caltech, USA), M. Meneghetti (INAF-Osservatorio Astronomico di Bologna, Italy), L. A. Moustakas (Caltech), L. Sodre Jr.(University of Sao Paulo, Brazil), J. Krick (Spitzer Science Center/IPAC/Caltech, USA) and J. N. Bregman (University of Michigan).
[2] This effect has been seen before in a few galaxy cluster collisions, including the original "Bullet Cluster" 1E 0657-56.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **ESA/Hubble Information Centre**.

Journal Reference:

1. J. Merten, D. Coe, R. Dupke, R. Massey, A. Zitrin, E.S. Cypriano, N. Okabe, B. Frye, F. Braglia, Y. Jimenez-Teja, N. Benitez, T. Broadhurst, J. Rhodes, M. Meneghetti, L.A. Moustakas, L. Sodre Jr., J. Krick, J.N. Bregman. **Creation of cosmic structure in the complex galaxy cluster merger Abell 2744**. *Monthly Notices of the Royal Astronomical Society*, 2011; (to be published) [link]

http://www.sciencedaily.com/releases/2011/06/110622133500.htm

Waste Heat Converted to Electricity Using New Alloy

During a small-scale demonstration in the lab, University of Minnesota researchers showed how their new material can spontaneously produce electricity when the temperature is raised a small amount. Pictured (from left) are aerospace engineering and mechanics professor Richard James, Ph.D. student Yintao Song and post-doctoral researchers Kanwal Bhatti and Vijay Srivastava. (Credit: Image courtesy of University of Minnesota)

ScienceDaily (June 22, 2011) — University of Minnesota engineering researchers in the College of Science and Engineering have recently discovered a new alloy material that converts heat directly into electricity. This revolutionary energy conversion method is in the early stages of development, but it could have wide-sweeping impact on creating environmentally friendly electricity from waste heat sources.

Researchers say the material could potentially be used to capture waste heat from a car's exhaust that would heat the material and produce electricity for charging the battery in a hybrid car. Other possible future uses include capturing rejected heat from industrial and power plants or temperature differences in the ocean to create electricity. The research team is looking into possible commercialization of the technology.

"This research is very promising because it presents an entirely new method for energy conversion that's never been done before," said University of Minnesota aerospace engineering and mechanics professor Richard James, who led the research team."It's also the ultimate 'green' way to create electricity because it uses waste heat to create electricity with no carbon dioxide."

To create the material, the research team combined elements at the atomic level to create a new multiferroic alloy, $Ni_{45}Co_5Mn_{40}Sn_{10}$. Multiferroic materials combine unusual elastic, magnetic and electric properties. The alloy $Ni_{45}Co_5Mn_{40}Sn_{10}$ achieves multiferroism by undergoing a highly reversible phase transformation where one solid turns into another solid. During this phase transformation the alloy undergoes changes in its magnetic properties that are exploited in the energy conversion device.

During a small-scale demonstration in a University of Minnesota lab, the new material created by the researchers begins as a non-magnetic material, then suddenly becomes strongly magnetic when the temperature is raised a small amount. When this happens, the material absorbs heat and spontaneously produces electricity in a surrounding coil. Some of this heat energy is lost in a process called hysteresis. A critical discovery of the team is a systematic way to minimize hysteresis in phase transformations. The team's research was recently published in the first issue of the new scientific journal *Advanced Energy Materials.*

Watch a short research video of the new material suddenly become magnetic when heated: http://z.umn.edu/conversionvideo.

In addition to Professor James, other members of the research team include University of Minnesota aerospace engineering and mechanics post-doctoral researchers Vijay Srivastava and Kanwal Bhatti, and Ph.D. student Yintao Song. The team is also working with University of Minnesota chemical engineering and materials science professor Christopher Leighton to create a thin film of the material that could be used, for example, to convert some of the waste heat from computers into electricity.

"This research crosses all boundaries of science and engineering," James said. "It includes engineering, physics, materials, chemistry, mathematics and more. It has required all of us within the university's College of Science and Engineering to work together to think in new ways."

Funding for early research on the alloy came from a Multidisciplinary University Research Initiative (MURI) grant from the U.S. Office of Naval Research (involving other universities including the California Institute of Technology, Rutgers University, University of Washington and University of Maryland), and research grants from the U.S. Air Force and the National Science Foundation. The research is also tentatively funded by a small seed grant from the University of Minnesota's Initiative for Renewable Energy and the Environment.

Story Source:

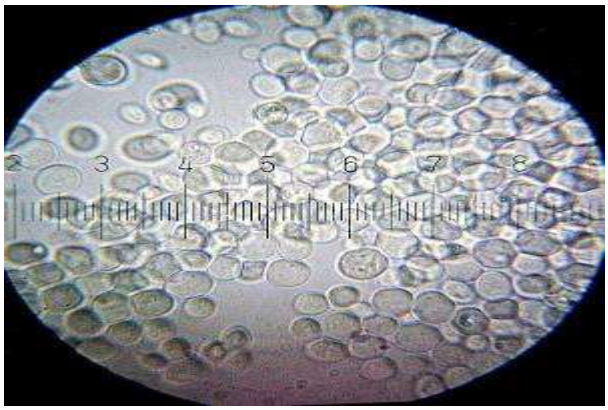
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Minnesota**.

Journal Reference:

1. Vijay Srivastava, Yintao Song, Kanwal Bhatti, R. D. James. **The Direct Conversion of Heat to Electricity Using Multiferroic Alloys**. *Advanced Energy Materials*, 2011; 1 (1): 97 DOI: 10.1002/aenm.201000048

http://www.sciencedaily.com/releases/2011/06/110622125706.htm

Evolution to the Rescue: Species May Adapt Quickly to Rapid Environmental Change



Moose. Evolution is usually thought to be a very slow process, something that happens over many generations, thanks to adaptive mutations. But environmental change due to things like climate change, habitat destruction, pollution, etc. is happening very fast. There are just two options for species of all kinds: either adapt to environmental change or become extinct. (Credit: © steve estvanik / Fotolia)

ScienceDaily (June 22, 2011) — Evolution is usually thought to be a very slow process, something that happens over many generations, thanks to adaptive mutations. But environmental change due to things like climate change, habitat destruction, pollution, etc. is happening very fast. There are just two options for species of all kinds: either adapt to environmental change or become extinct.

So, according to McGill biology professor, Andrew Gonzalez, the question arises, "Can evolution happen quickly enough to help a species survive?" The answer, according to his most recent study, published in *Science*, is a resounding yes.

By using a long-armed robot working 24/7 over a period of several of months, McGill Professors Graham Bell and Gonzalez were able to track the fate of over 2000 populations of baker's yeast for many generations. Yeast was chosen for the experiment because a lot is known about the genetic makeup of this model organism and because it can reproduce in a matter of hours. Bell and Gonzalez used the robot to submit different yeast populations to varying degrees of environmental stress in the form of salt and so study evolutionary rescue, which is the ability of a population to adapt rapidly through evolution, in real time.

What they observed was that the likelihood of evolutionary rescue depended on the severity and rate of change of the environment and the degree of prior exposure of populations to the environmental stressor (salt). The degree of isolation from neighboring populations also affected the capacity of the yeast populations to adapt through the accumulation of beneficial mutations.

Gonzalez and his team were in effect watching evolution at work. And what they discovered is that it can happen surprisingly fast, within 50 -- 100 generations.

"The same general processes are occurring whether it's yeast or mammals," said Gonzalez. "At the end of the day we can't do the experiment with a panda or a moose, for example, because the time it would take to study their evolution is far longer than the time we have given the current rate of environmental change. At some point we have to work at the level of a model and satisfy ourselves that the basic reality we capture is sufficient to extrapolate from." While there has been theoretical work on the subject done in the past, this is the first time anyone has done a practical experiment of this kind, and shown evolutionary rescue at work.

More detailed information about the findings

Bell and Gonzalez discovered that a population was more likely to adapt quickly through evolutionary rescue if:

1. There was slow environmental deterioration, i.e. a slow increase in the concentration of salt, along with modest levels of contact with other populations. These populations were then able to adapt to environmental stress that would have been sufficient to eradicate their ancestors.

2. It was connected by dispersal, i.e. had previous contact, with another population that had already experienced environmental change. This population then had a much greater probability of avoiding extinction after a rapid and severe perturbation.

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

Journal Reference:

1. G. Bell, A. Gonzalez. **Adaptation and Evolutionary Rescue in Metapopulations Experiencing Environmental Deterioration**. *Science*, 2011; 332 (6035): 1327 DOI: 10.1126/science.1203105

http://www.sciencedaily.com/releases/2011/06/110622115311.htm

Fastest Sea-Level Rise in 2,000 Years Linked to Increasing Global Temperatures

Rising seas lap at the house in "Nights in Rodanthe," filmed during the field work. (Credit: Andrew Kemp, Yale University)

ScienceDaily (June 21, 2011) — The rate of sea level rise along the U.S. Atlantic coast is greater now than at any time in the past 2,000 years -- and has shown a consistent link between changes in global mean surface temperature and sea level.

The findings are published in the journal *Proceedings of the National Academy of Sciences* (PNAS).

The research, funded by the National Science Foundation (NSF), was conducted by Andrew Kemp, Yale University; Benjamin Horton, University of Pennsylvania; Jeffrey Donnelly, Woods Hole Oceanographic Institution; Michael Mann, Pennsylvania State University; Martin Vermeer, Aalto University School of Engineering, Finland; and Stefan Rahmstorf, Potsdam Institute for Climate Impact Research, Germany.

"Having a detailed picture of rates of sea level change over the past two millennia provides an important context for understanding current and potential future changes," says Paul Cutler, program director in NSF's Division of Earth Sciences.

"It's especially valuable for anticipating the evolution of coastal systems," he says, "in which more than half the world's population now lives."

Adds Kemp, "Scenarios of future rise are dependent on understanding the response of sea level to climate changes. Accurate estimates of past sea-level variability provide a context for such projections."

Kemp and colleagues developed the first continuous sea-level reconstruction for the past 2,000 years, and compared variations in global temperature to changes in sea level over that time period.

The team found that sea level was relatively stable from 200 BC to 1,000 AD.

Then in the 11th century, sea level rose by about half a millimeter each year for 400 years, linked with a warm climate period known as the Medieval Climate Anomaly.

Then there was a second period of stable sea level during a cooler period called the Little Ice Age. It persisted until the late 19th century.

Since the late 19th century, sea level has risen by more than 2 millimeters per year on average, the steepest rate for more than 2,100 years.

"Sea-level rise is a potentially disastrous outcome of climate change," says Horton, "as rising temperatures melt land-based ice, and warm ocean waters."

To reconstruct sea level, the scientists used microfossils called foraminifera preserved in sediment cores extracted from coastal salt marshes in North Carolina. The age of the cores was estimated using radiocarbon dating and other techniques.

To test the validity of their approach, the team compared its reconstructions with tide-gauge measurements from North Carolina for the past 80 years, and global tide-gauge records for the past 300 years.

A second reconstruction from Massachusetts confirmed their findings.

The records were corrected for contributions to sea-level rise made by vertical land movements.

The reconstructed changes in sea level over the past millennium are consistent with past global temperatures, the researchers say, and can be determined using a model relating the rate of sea level rise to global temperature.
"Data from the past helped calibrate our model, and will improve sea level rise projections under scenarios of future temperature increases," says Rahmstorf.
Support for the research also was provided by the National Oceanic and Atmospheric Administration, United States Geological Survey, the Academy of Finland, the European Science Foundation through European Cooperation in Science and Technology and the University of Pennsylvania.

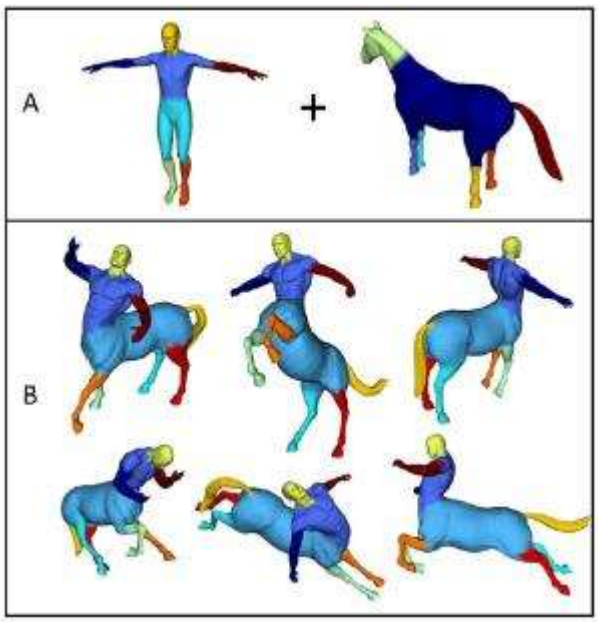
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Science Foundation**.

Journal Reference:

1. Andrew C. Kemp, Benjamin P. Horton, Jeffrey P. Donnelly, Michael E. Mann, Martin Vermeer, Stefan Rahmstorf. **Climate related sea-level variations over the past two millennia**. *Proceedings of the National Academy of Sciences*, 2011; DOI: 10.1073/pnas.1015619108

http://www.sciencedaily.com/releases/2011/06/110620183242.htm

Genius of Einstein, Fourier Key to New Computer Vision That Mimics How Humans Perceive 3-D Shapes



Researchers developing a new machine-vision technique tested their method on certain complex shapes, including the human form or a centaur, a mythical half-human, half-horse creature. The heat mapping allows a computer to recognize the objects no matter how the figures are bent or twisted and is able to ignore "noise" introduced by imperfect laser scanning or other erroneous data. (Credit: Purdue University image/Karthik Ramani and Yi Fang)

ScienceDaily (June 21, 2011) — Two new techniques for computer-vision technology mimic how humans perceive three-dimensional shapes by instantly recognizing objects no matter how they are twisted or bent, an advance that could help machines see more like people.

The techniques, called heat mapping and heat distribution, apply mathematical methods to enable machines to perceive three-dimensional objects, said Karthik Ramani, Purdue University's Donald W. Feddersen Professor of Mechanical Engineering.

"Humans can easily perceive 3-D shapes, but it's not so easy for a computer," he said. "We can easily separate an object like a hand into its segments -- the palm and five fingers -- a difficult operation for computers."

Both of the techniques build on the basic physics and mathematical equations related to how heat diffuses over surfaces.

"Albert Einstein made contributions to diffusion, and 18th century physicist Jean Baptiste Joseph Fourier developed Fourier's law, used to derive the heat equation," Ramani said. "We are standing on the shoulders of giants in creating the algorithms for these new approaches using the heat equation."

As heat diffuses over a surface it follows and captures the precise contours of a shape. The system takes advantage of this "intelligence of heat," simulating heat flowing from one point to another and in the process characterizing the shape of an object, he said.

Findings will be detailed in two papers being presented during the IEEE Computer Vision and Pattern Recognition conference on June 21-23 in Colorado Springs. The paper was written by Ramani, Purdue doctoral students Yi Fang and Mengtian Sun, and Minhyong Kim, a professor of pure mathematics at the University College London.

A major limitation of existing methods is that they require "prior information" about a shape in order for it to be analyzed.

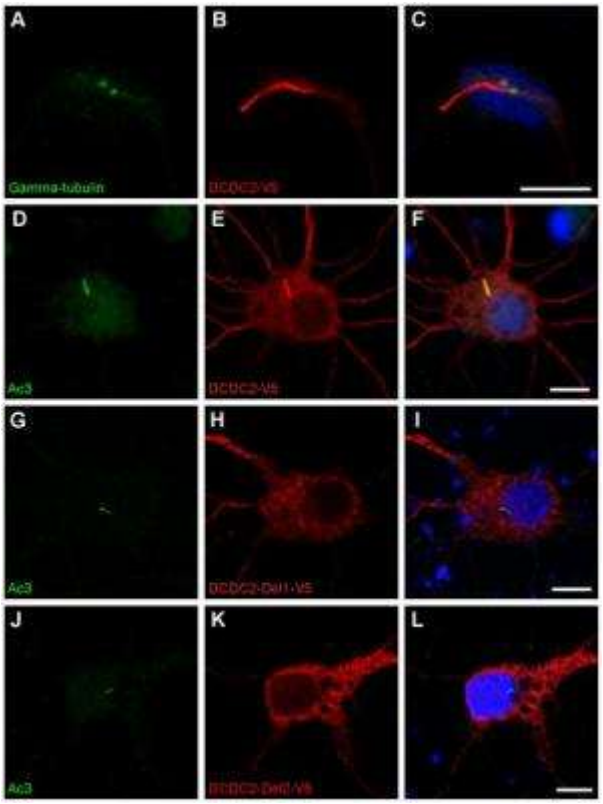
"For example, in order to do segmentation you have to tell the computer ahead of time how many segments the object has," Ramani said. "You have to tell it that you are expecting, say, 10 segments or 12 segments."

The new methods mimic the human ability to properly perceive objects because they don't require a preconceived idea of how many segments exist.
"We are trying to come as close as possible to human segmentation," Ramani said. "A hot area right now is unsupervised machine learning. This means a machine, such as a robot, can perceive and learn without having any previous training. We are able to estimate the segmentation instead of giving a predefined number of segments."
The work is funded partially by the National Science Foundation. A patent on the technology is pending.
The methods have many potential applications, including a 3-D search engine to find mechanical parts such as automotive components in a database; robot vision and navigation; 3-D medical imaging; military drones; multimedia gaming; creating and manipulating animated characters in film production; helping 3-D cameras to understand human gestures for interactive games; contributing to progress of areas in science and engineering related to pattern recognition; machine learning; and computer vision.
The heat-mapping method works by first breaking an object into a mesh of triangles, the simplest shape that can characterize surfaces, and then calculating the flow of heat over the meshed object. The method does not involve actually tracking heat; it simulates the flow of heat using well-established mathematical principles, Ramani said.
Heat mapping allows a computer to recognize an object, such as a hand or a nose, no matter how the fingers are bent or the nose is deformed and is able to ignore "noise" introduced by imperfect laser scanning or other erroneous data.
"No matter how you move the fingers or deform the palm, a person can still see that it's a hand," Ramani said. "But for a computer to say it's still a hand is going to be hard. You need a framework -- a consistent, robust algorithm that will work no matter if you perturb the nose and put noise in it or if it's your nose or mine."
The method accurately simulates how heat flows on the object while revealing its structure and distinguishing unique points needed for segmentation by computing the "heat mean signature." Knowing the heat mean signature allows a computer to determine the center of each segment, assign a "weight" to specific segments and then define the overall shape of the object.
"Being able to assign a weight to segments is critical because certain points are more important than others in terms of understanding a shape," Ramani said. "The tip of the nose is more important than other points on the nose, for example, to properly perceive the shape of the nose or face, and the tips of the fingers are more important than many other points for perceiving a hand."
In temperature distribution, heat flow is used to determine a signature, or histogram, of the entire object.
"A histogram is a two-dimensional mapping of a three-dimensional shape," Ramani said. "So, no matter how a dog bends or twists, it gives you the same signature."
The temperature distribution technique also uses a triangle mesh to perceive 3-D shapes. Both techniques, which could be combined in the same system, require modest computer power and recognize shapes quickly, he said.
"It's very efficient and very compact because you're just using a two-dimensional histogram," Ramani said. "Heat propagation in a mesh happens very fast because the mathematics of matrix computations can be done very quickly and well."
The researchers tested their method on certain complex shapes, including hands, the human form or a centaur, a mythical half-human, half-horse creature.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Purdue University**. The original article was written by Emil Venere.

http://www.sciencedaily.com/releases/2011/06/110620161310.htm

Unexpected Function of Dyslexia-Linked Gene: Controlling Cilia of Cells



Full-length V5-tagged DCDC2 localizes to the primary cilium in neurons. Confocal images of rat primary hippocampal neurons transfected with DCDC2-V5 and labeled with a centriolar marker gamma-tubulin (A) or the neuronal ciliary marker Ac3 (D) and the V5 epitope (B and E). Nuclei were stained with DAPI (blue). The merged image shows colocalization of Ac3 and DCDC2-V5 in the primary cilium (F). Neurons transfected with deletion constructs of DCDC2 lacking either of the two doublecortin domains do not show ciliary localization of the protein (G–L). Scale bars indicate 10 µm. (Credit: Massinen S, Hokkanen M-E, Matsson H, Tammimies K, Tapia-Páez I, et al. (2011) Increased Expression of the Dyslexia Candidate Gene DCDC2 Affects Length and Signaling of Primary Cilia in Neurons. PLoS ONE 6(6): e20580. doi:10.1371/journal.pone.0020580)

ScienceDaily (June 21, 2011) — Scientists at Karolinska Institutet in Sweden have discovered that a gene linked to dyslexia has a surprising biological function: it controls cilia, the antenna-like projections that cells use to communicate.

Dyslexia is largely hereditary and linked to a number of genes, the functions of which are, however, largely unknown. This present study from Karolinska Institutet and Helsinki University now shows that one of these genes, DCDC2, is involved in regulating the signalling of cilia in brain neurons.

"Our discovery presents us with a possible new neurobiological mechanism for dyslexia," says Professor Juha Kere, who co-led the study with Professor Eero Castrén of Helsinki University.

Cilia are hair-like structures that project from the surface of most cells. Their purpose has long remained something of a mystery, but recent research has revealed that the cells use them to communicate and that they play a crucial part in the development of the body's organs.

These results tie into previous research in mice showing that DCDC2 and two other dyslexia genes are involved in cell migration, a process by which nerve cells are moved to their correct location in the brain during embryonic development.

"The cilia are important parts of the machinery that controls cell migration," says Professor Kere. "Just what they do and how it could result in dyslexia are interesting questions that will be given further study."

The new findings, which are presented in the scientific journal *PLoS ONE* show that DCDC2 governs the length of the cilia and activates two different signal systems in the cell, depending on the degree of gene activity. When the human variant of the gene was transferred to nerve cells in the roundworm *C. elegans*, it gave rise to unusual neural projections exclusively in ciliated cells.
Ciliary dysfunction in different organs has been associated with a wide range of disorders from rare genetic diseases such as polycystic kidney disease and Kartagener's syndrome, to diabetes, obesity and schizophrenia.

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

Journal Reference:

1. Satu Massinen, Marie-Estelle Hokkanen, Hans Matsson, Kristiina Tammimies, Isabel Tapia-Páez, Vanina Dahlström-Heuser, Juha Kuja-Panula, Jan Burghoorn, Kristian E. Jeppsson, Peter Swoboda, Myriam Peyrard-Janvid, Rune Toftgård, Eero Castrén, Juha Kere. **Increased expression of the dyslexia candidate gene DCDC2 affects length and signaling of primary cilia in neurons**. *PLoS ONE*, 16 June 2011; 6 (6): e20580 DOI: 10.1371/journal.pone.0020580

http://www.sciencedaily.com/releases/2011/06/110620094854.htm

Mystery Ingredient in Coffee Boosts Protection Against Alzheimer's Disease, Study Finds

A yet unidentified component of coffee interacts with the beverage's caffeine, which could be a surprising reason why daily coffee intake protects against Alzheimer's disease. (Credit: © Subbotina Anna / Fotolia)

ScienceDaily (June 21, 2011) — A yet unidentified component of coffee interacts with the beverage's caffeine, which could be a surprising reason why daily coffee intake protects against Alzheimer's disease. A new Alzheimer's mouse study by researchers at the University of South Florida found that this interaction boosts blood levels of a critical growth factor that seems to fight off the Alzheimer's disease process.

The findings appear in the early online version of an article to be published June 28 in the *Journal of Alzheimer's Disease*. Using mice bred to develop symptoms mimicking Alzheimer's disease, the USF team presents the first evidence that caffeinated coffee offers protection against the memory-robbing disease that is not possible with other caffeine-containing drinks or decaffeinated coffee.

Previous observational studies in humans reported that daily coffee/caffeine intake during mid-life and in older age decreases the risk of Alzheimer's disease. The USF researchers' earlier studies in Alzheimer's mice indicated that caffeine was likely the ingredient in coffee that provides this protection because it decreases brain production of the abnormal protein beta-amyloid, which is thought to cause the disease.

The new study does not diminish the importance of caffeine to protect against Alzheimer's. Rather it shows that caffeinated coffee induces an increase in blood levels of a growth factor called GCSF (granulocyte colony stimulating factor). GCSF is a substance greatly decreased in patients with Alzheimer's disease and demonstrated to improve memory in Alzheimer's mice. A just-completed clinical trial at the USF Health Byrd Alzheimer's Institute is investigating GCSF treatment to prevent full-blown Alzheimer's in patients with mild cognitive impairment, a condition preceding the disease. The results of that trial are currently being evaluated and should be known soon.

"Caffeinated coffee provides a natural increase in blood GCSF levels," said USF neuroscientist Dr. Chuanhai Cao, lead author of the study. "The exact way that this occurs is not understood. There is a synergistic interaction between caffeine and some mystery component of coffee that provides this beneficial increase in blood GCSF levels."

The researchers would like to identify this yet unknown component so that coffee and other beverages could be enriched with it to provide long-term protection against Alzheimer's.

In their study, the researchers compared the effects of caffeinated and decaffeinated coffee to those of caffeine alone. In both Alzheimer's mice and normal mice, treatment with caffeinated coffee greatly increased blood levels of GCSF; neither caffeine alone or decaffeinated coffee provided this effect. The researchers caution that, since they used only "drip" coffee in their studies, they do not know whether "instant" caffeinated coffee would provide the same GCSF response.

The boost in GCSF levels is important, because the researchers also reported that long-term treatment with coffee (but not decaffeinated coffee) enhances memory in Alzheimer's mice. Higher blood GCSF levels due to coffee intake were associated with better memory. The researchers identified three ways that GCSF seems to improve memory performance in the Alzheimer's mice. First, GCSF recruits stem cells from bone marrow to enter the brain and remove the harmful beta-amyloid protein that initiates the disease. GCSF also creates new connections between brain cells and increases the birth of new neurons in the brain.

"All three mechanisms could complement caffeine's ability to suppress beta amyloid production in the brain" Dr. Cao said, "Together these actions appear to give coffee an amazing potential to protect against Alzheimer's -- but only if you drink moderate amounts of caffeinated coffee."

Although the present study was performed in Alzheimer's mice, the researchers indicated that they've gathered clinical evidence of caffeine/coffee's ability to protect humans against Alzheimer's and will soon publish those findings.

Coffee is safe for most Americans to consume in the moderate amounts (4 to 5 cups a day) that appear necessary to protect against Alzheimer's disease. The USF researchers previously reported this level of coffee/caffeine intake was needed to counteract the brain pathology and memory impairment in Alzheimer's mice. The average American drinks 1½ to 2 cups of coffee a day, considerably less than the amount the researchers believe protects against Alzheimer's.

"No synthetic drugs have yet been developed to treat the underlying Alzheimer's disease process" said Dr. Gary Arendash, the study's other lead author. "We see no reason why an inherently natural product such as coffee cannot be more beneficial and safer than medications, especially to protect against a disease that takes decades to become apparent after it starts in the brain."

The researchers believe that moderate daily coffee intake starting at least by middle age (30s -- 50s) is optimal for providing protection against Alzheimer's disease, although starting even in older age appears protective from their studies. "We are not saying that daily moderate coffee consumption will completely protect people from getting Alzheimer's disease," Dr. Cao said. "However, we do believe that moderate coffee consumption can appreciably reduce your risk of this dreaded disease or delay its onset."

The researchers conclude that coffee is the best source of caffeine to counteract the cognitive decline of Alzheimer's because its yet unidentified component synergizes with caffeine to increase blood GCSF levels. Other sources of caffeine, such as carbonated drinks, energy drinks, and tea, would not provide the same level of protection against Alzheimer's as coffee, they said.

Coffee also contains many ingredients other than caffeine that potentially offer cognitive benefits against Alzheimer's disease. "The average American gets most of their daily antioxidants intake through coffee," Dr. Cao said. "Coffee is high in anti-inflammatory compounds that also may provide protective benefits against Alzheimer's disease."

An increasing body of scientific literature indicates that moderate consumption of coffee decreases the risk of several diseases of aging, including Parkinson's disease, Type II diabetes and stroke. Just within the last few months, new studies have reported that drinking coffee in moderation may also significantly reduce the risk of breast and prostate cancers.

"Now is the time to aggressively pursue the protective benefits of coffee against Alzheimer's disease," Dr. Arendash said. "Hopefully, the coffee industry will soon become an active partner with Alzheimer's researchers to find the protective ingredient in coffee and concentrate it in dietary sources."

New Alzheimer's diagnostic guidelines, now encompassing the full continuum of the disease from no overt symptoms to mild impairment to clear cognitive decline, could double the number of Americans with some form of the disease to more than 10 million. With the baby-boomer generation entering older age, these numbers will climb even more unless an effective preventive measure is identified.

"Because Alzheimer's starts in the brain several decades before it is diagnosed, any protective therapy would obviously need to be taken for decades," Dr. Cao said. "We believe moderate daily consumption of caffeinated coffee is the best current option for long-term protection against Alzheimer's memory loss. Coffee is inexpensive, readily available, easily gets into the brain, appears to directly attack the disease process, and has few side-effects for most of us."

According to the researchers, no other Alzheimer's therapy being developed comes close to meeting all these criteria.

"Aside from coffee, two other lifestyle choices -- physical and cognitive activity -- appear to reduce the risk of dementia. Combining regular physical and mental exercise with moderate coffee consumption would seem to be an excellent multi-faceted approach to reducing risk or delaying Alzheimer's," Dr. Arendash said. "With pharmaceutical companies spending millions of dollars trying to develop drugs against Alzheimer's disease, there may very well be an effective preventive right under our noses every morning -- caffeinated coffee." This USF study was funded by the NIH-designated Florida Alzheimer's Disease Research Center and the State of Florida.

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

Journal Reference:

1. Chuanhai Cao, Li Wang, Xiaoyang Lin, Malgorzata Mamcarz, Chi Zhang, Ge Bai, Jasson Nong, Sam Sussman and Gary Arendash. **Caffeine Synergizes with Another Coffee Component to Increase Plasma GCSF: Linkage to Cognitive Benefits in Alzheimer's Mice**. *Journal of Alzheimer's Disease*, 25(2), June 28, 2011

http://www.sciencedaily.com/releases/2011/06/110621093301.htm

Buzz Kills: No Amount of Alcohol Safe to Drive

New research finds that blood-alcohol levels well below the U.S. legal limit are associated with incapacitating injury and death. (Credit: © TheSupe87 / Fotolia)

ScienceDaily (June 20, 2011) — In the United States, the blood-alcohol limit may be 0.08 percent, but no amount of alcohol seems to be safe for driving, according to a University of California, San Diego sociologist. A study led by David Phillips and published in the journal *Addiction* finds that blood-alcohol levels well below the U.S. legal limit are associated with incapacitating injury and death.

Phillips, with coauthor Kimberly M. Brewer, also of UC San Diego, examined official data from the Fatality Analysis Reporting System (FARS). This dataset includes information on all persons in the U.S. who were involved in fatal car accidents -- 1,495,667 people in the years 1994 to 2008. The researchers used FARS because it is nationally comprehensive, covering all U.S. counties, all days of the week and all times of day, and, perhaps most important, reports on blood-alcohol content in increments of 0.01.

All the accidents included in FARS are, by definition, severe. But the authors looked at different levels of accident severity by examining the ratio of severe injuries to minor ones.

"Accidents are 36.6 percent more severe even when alcohol was barely detectable in a driver's blood," Phillips said. Even with a BAC of 0.01, Phillips and Brewer write, there are 4.33 serious injuries for every non-serious injury versus 3.17 for sober drivers.

There are at least three mechanisms that help to explain this finding, Phillips said: "Compared with sober drivers, buzzed drivers are more likely to speed, more likely to be improperly seat-belted and more likely to drive the striking vehicle, all of which are associated with greater severity."

There also seems to be a strong "dose-response" relationship between all these factors, the authors write: The greater the blood-alcohol content, the greater the average speed of the driver and the greater the severity of the accident, for example.

The findings persist even when such potentially confounding variables as inattention and fatigue are excluded from the analysis.

In general, accident severity is significantly higher on weekends, between 8 p.m. and 4 a.m. and in the summer months, June through August. But when the researchers standardized for day of the week, for time of day and for month, the relationship between BAC and more dangerous car accidents also persisted.

"Up till now, BAC limits have been determined not only by rational considerations and by empirical findings but also by political and cultural factors," Phillips said, citing as evidence that the U.S. national standard of

0.08 is relatively recent and that BAC limits vary greatly by country. In Germany, the limit is 0.05; in Japan, 0.03; and in Sweden, 0.02.
"We hope that our study might influence not only U.S. legislators, but also foreign legislators, in providing empirical evidence for lowering the legal BAC even more," Phillips said. "Doing so is very likely to reduce incapacitating injuries and to save lives."
The research was funded by the Marian E. Smith Foundation.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of California - San Diego**. The original article was written by Inga Kiderra.

Journal Reference:

1. David P. Phillips, Kimberly M. Brewer. **The relationship between serious injury and blood alcohol concentration (BAC) in fatal motor 0.01% is associated with significantly more = vehicle accidents: BAC 0.00% = dangerous accidents than BAC**. *Addiction*, 2011; DOI: 10.1111/j.1360-0443.2011.03472.x

http://www.sciencedaily.com/releases/2011/06/110620103933.htm

Fat Substitutes Linked to Weight Gain: Rats On High-Fat Diet Gained More Weight After Eating Low-Calorie Potato Chips Made With Fat Substitutes

New research suggests that synthetic fat substitutes used in low-calorie potato chips and other foods could backfire and contribute to weight gain and obesity. (Credit: © kentoh / Fotolia)

ScienceDaily (June 20, 2011) — Synthetic fat substitutes used in low-calorie potato chips and other foods could backfire and contribute to weight gain and obesity, according to a study published by the American Psychological Association.

The study, by researchers at Purdue University, challenges the conventional wisdom that foods made with fat substitutes help with weight loss. "Our research showed that fat substitutes can interfere with the body's ability to regulate food intake, which can lead to inefficient use of calories and weight gain," said Susan E. Swithers, PhD, the lead researcher and a Purdue psychology professor. The study was published online in the APA journal *Behavioral Neuroscience*.

The study used laboratory rats that were fed either a high-fat or low-fat diet of chow. Half of the rats in each group also were fed potato chips that are high in fat and calories. The remaining rats in each group were fed high-calorie chips on some days and low-calorie chips on other days. The low-calorie chips are made with olestra, a synthetic fat substitute that has zero calories and passes through the body undigested.

For rats on the high-fat diet, the group that ate both types of potato chips consumed more food, gained more weight and developed more fatty tissue than the rats that ate only the high-calorie chips. The fat rats also didn't lose the extra weight even after the potato chips were removed from their diet. "Based on this data, a diet that is low in fat and calories might be a better strategy for weight loss than using fat substitutes," Swithers said. However, she warned that it can be difficult to extrapolate laboratory findings about rats to people, even though their biological responses to food are similar. The study was conducted by Swithers along with Purdue psychology professor Terry L. Davidson, PhD, and former Purdue undergraduate student Sean Ogden.

Why would a fat substitute confuse the body? Food with a sweet or fatty taste usually indicates a large number of calories, and the taste triggers various responses by the body, including salivation, hormonal secretions and metabolic reactions. Fat substitutes can interfere with that relationship when the body expects to receive a large burst of calories but is fooled by a fat substitute.

There is some good news if a diet is naturally low in fat. The rats that were fed a low-fat diet didn't experience significant weight gain from either type of potato chips. However, when those same rats were switched to a high-fat diet, the rats that had eaten both types of potato chips ate more food and gained more weight and body fat than the rats that had eaten only the high-calorie chips.

Swithers and Davidson have reported similar findings in previous rat studies that showed saccharin and other artificial sweeteners also can promote weight gain and increased body fat. The use of artificial sweeteners and fat substitutes has increased dramatically over the past 30 years, mirroring the increase in obesity in America. Dieters have turned to these artificial means to lower calories while still eating foods that taste sweet or fatty. So what is a dieter supposed to do to drop a size?

"Unfortunately, there is no silver bullet," Swithers said. "Eating food which is naturally low in fat and calories may be a better route than relying on fat substitutes or artificial sweeteners."

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

Journal Reference:

1. Susan E. Swithers, Sean B. Ogden and Terry L. Davidson. **Fat Substitutes Promote Weight Gain in Rats Consuming High-Fat Diets**. *Behavioral Neuroscience*, 2011; 125 (4)

http://www.sciencedaily.com/releases/2011/06/110620151005.htm

Shock and Recall: Negative Emotion May Enhance Memory

Scream mask. Picture a menacing drill sergeant, a gory slaughterhouse, a devastating scene of a natural disaster. Researchers at Washington University in St. Louis have found that viewing such emotion-laden images immediately after taking a test actually enhances people's retention of the tested material. (Credit: © Coka / Fotolia)

ScienceDaily (June 20, 2011) — Picture a menacing drill sergeant, a gory slaughterhouse, a devastating scene of a natural disaster. Researchers at Washington University in St. Louis have found that viewing such emotion-laden images immediately after taking a test actually enhances people's retention of the tested material.

The data the researchers gathered in recent studies are the first to show that negative arousal following successful retrieval of information enhances later recall of that information.

The finding is counterintuitive. One would think that viewing a negative scene would tend to blot out anything learned before seeing the image.

Instead, learning is enhanced by the (negative) emotion, says Bridgid Finn, PhD, postdoctoral researcher in psychology in Arts & Sciences. "Memory is labile and dynamic -- after you retrieve something, you're still engaged in processing that information in some way," Finn says.

"Having a picture of a gun pointed at you just after you've just been tested on something probably isn't the best situation for learning, but because there is an intricate relationship between areas involved in emotion and remembering, the amygdala and the hippocampus, we find that the negative picture can enhance later retention."

Finn and Henry L. Roediger III, PhD, James S. McDonnell Distinguished University Professor and dean of academic planning, published their findings in the June 2011 issue of Psychological Science.

The researchers tested 40 undergraduate WUSTL students who studied ten lists of ten pairs of Swahili-English vocabulary items (lulu/pearl; ubini/forgery). Participants were given a cued recall test after studying each set of ten pairs, and then given a final test on all 100 pairs.

On the initial test, following each correct answer, they were shown a picture either of a negative emotional image such as a pointed gun; a neutral image, such as a chair, or a blank screen.

They then did a one-minute multiplication test, a sort of mental palette cleansing to remove the effects of short-term memory, like a serving of sherbet in a multiple course meal.

A final cued-recall test on all 100 Swahili-English items revealed that participants did best on items that had been followed by the negative pictures.

This initial experiment showed that the process involved in retrieving an item does not end when that item is retrieved. In a second experiment designed to explore the limits of the enhancement effect, the researchers tested a second group of students who viewed the images two seconds after successful retrieval. The question: Does the retrieval process persist during those two seconds?

"The answer appears to be yes, the students continue to process the information during the two second pause," Finn says.

A third study of 61 students was intended to rule out the possibility that arousing images simply made certain pairs of words seem more distinct, and thus made them easier to remember. This experiment was very similar to the other two with one major distinction: Instead of taking the initial tests, participants restudied the items.
"For negative emotion to enhance later retention of something, this experiment shows that you have to retrieve that information," Finn says. "That is, you have to go get it. In the absence of retrieval, the negative pictures do not enhance later performance. That's critical."
The study revealed no gender differences in participants' success rates. Finn and Roediger did not measure the effects of physiological parameters such as adrenaline or hormonal responses in connection with the negative arousal.
Importantly, other studies Finn and Roediger are doing thus far show that positive images do not enhance retrieval or retention. For instance, preliminary data on a study of participants who were tested on items that were followed by sexually arousing images show no learning enhancement. While the pictures were arousing, they weren't linked to enhanced retrieval on the later test.
"Positive content, so far, doesn't seem to be doing the trick," Finn says.
The researchers believe that their results mark the first step in understanding the kinds of things that might be beneficial to enhance memory after retrieval.
"We've established that the period after retrieval is key in retaining information," Finn says. "We want to build on that foundation and explore it in depth. We want to see what kinds of manipulations can possibly be introduced in the post-retrieval phase to understand when enhancement or impairment of retention might occur."

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Washington University in St. Louis**. The original article was written by Tony Fitzpatrick.

Journal Reference:

1. B. Finn, H. L. Roediger. **Enhancing Retention Through Reconsolidation: Negative Emotional Arousal Following Retrieval Enhances Later Recall**. *Psychological Science*, 2011; 22 (6): 781 DOI: 10.1177/0956797611407932

http://www.sciencedaily.com/releases/2011/06/110620094601.htm

Did Climate Change Cause Greenland's Ancient Viking Community to Collapse?

Greenland. (Credit: © Nouk / Fotolia)

ScienceDaily (June 20, 2011) — Our changing climate usually appears to be a very modern problem, yet new research from Greenland published in Boreas, suggests that the AD 1350 collapse of a centuries old colony established by Viking settlers may have been caused by declining temperatures and a rise in sea-ice. The authors suggest the collapse of the Greenland Norse presents a historical example of a society which failed to adapt to climate change.

The research, led by Dr Sofia Ribeiro from the University of Copenhagen, currently at the Geological Survey of Denmark and Greenland, focused on Disko Bay in Western Greenland and used a marine sediment record to reconstruct climate change over the last 1500 years.

Events which occurred during this time frame included the arrival of Norse settlers, led by Eric the Red in AD 985. After establishing a colony known as the Western Settlement the Norse traveled north to Disko Bay, a prime hunting ground for walruses and seals.

"Our study indicates that at the time the Norse arrived in West Greenland, climate conditions were relatively mild and were favorable to the settlers," said Ribeiro. "However, in AD 1350 the settlement collapsed, the cause of which has long been debated."

The marine perspective of the research is especially relevant as the Norse inhabited inner fjord areas. The team's research compared robust air temperature reconstructions based on ice-core data with their own marine record. The results underline the regional complexity of climate patterns in the study area, which may vary from ice core reconstructions, and are strongly controlled by the fluctuating influence of "warm" Atlantic waters entrained by the West Greenland Current.

"Our study shows a major shift towards cooler conditions and extensive sea-ice which coincides with the estimated time for the collapse of the Western Settlement in AD 1350," said Dr Ribeiro. "The Norse were proud of being Europeans, farmers and Christians, and never adopted the hunting and survival techniques of the Inuit, so these temperature shifts would have caused significant problems for the colonists and their livestock."

Agricultural difficulties are believed to have forced the Norse to rely on marine resources, yet the increase in sea-ice, the team suggests, would have had a major impact on species such as migratory seals, while blocking trade routes.

"We cannot attribute the end of the Norse civilisation to a single factor, but there is enough evidence to suggest that climate change played a major role in determining its collapse," concluded Ribeiro. "Harsh climate conditions made farming and cattle production increasingly difficult and the extensive sea-ice prevented navigation and trading with Europe."

"There is perhaps an important lesson to learn from the Norse collapse and that is a lesson of adaptation, of being able to adjust our values and life-style when times change. That is an important challenge we face today as a society."

Story Source:

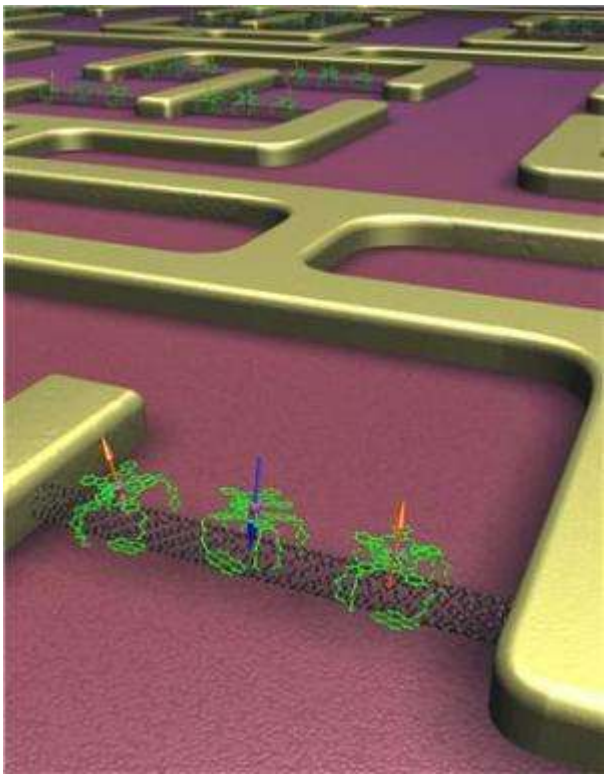
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Wiley-Blackwell**, via AlphaGalileo.

Journal Reference:

1. Sofia Ribeiro, Matthias Moros, Marianne Ellegaard, Antoon Kuijpers. **Climate variability in West Greenland during the past 1500 years: evidence from a high-resolution marine palynological record from Disko Bay**. *Boreas*, 2011; DOI: 10.1111/j.1502-3885.2011.00216.x

http://www.sciencedaily.com/releases/2011/06/110620095238.htm

Self-Assembling Electronic Nano-Components



"Self-organization" of nano-devices: Magnetic molecules (green) arrange on a carbon nanotube (black) to build an electronic component. (Credit: C. Grupe, KIT)

ScienceDaily (June 20, 2011) — Magnetic storage media such as hard drives have revolutionized the handling of information: huge quantities of data are magnetically stored while relying on highly sensitive electronic components. And data capacities are expected to increase further through ever smaller components. Together with experts from Grenoble and Strasbourg, researchers of KIT's Institute of Nanotechnology (INT) have now developed a nano-component based on a mechanism observed in nature.

What if the very tininess of a component prevented one from designing the necessary tools for its manufacture? One possibility could be to "teach" the individual parts to self-assemble into the desired product. For fabrication of an electronic nano-device, a team of INT researchers headed by Mario Ruben adopted a trick from nature: Synthetic adhesives were applied to magnetic molecules in such a way that the latter docked on to the proper positions on a nanotube without any intervention. In nature, green leaves grow through a similar self-organizing process without any impetus from subordinate mechanisms. The adoption of such principles to the manufacture of electronic components is a paradigm shift, a novelty.

The nano-switch was developed by a European team of scientists from Centre National de la Recherche Scientifique (CNRS) in Grenoble, Institut de Physique et Chimie des Matériaux at the University of Strasbourg, and KIT's INT. It is one of the invention's particular features that, unlike the conventional electronic components, the new component does not consist of materials such as metals, alloys or oxides but entirely of soft materials such as carbon nanotubes and molecules.

Terbium, the only magnetic metal atom that is used in the device, is embedded in organic material. Terbium reacts highly sensitively to external magnetic fields. Information as to how this atom aligns along such magnetic fields is efficiently passed on to the current flowing through the nanotube. The Grenoble CNRS research group headed by Dr. Wolfgang Wernsdorfer succeeded in electrically reading out the magnetism in the environment of the nano-component. The demonstrated possibility of addressing electrically single magnetic molecules opens a completely new world to spintronics, where memory, logic and possibly quantum logic may be integrated.

The function of the spintronic nano-device is described in the July issue of Nature Materials (DOI number: 10.1038/Nmat3050)for low temperatures of approximately one degree Kelvin, which is -272 degrees Celsius. Efforts are taken by the team of researchers to further increase the component's working temperature in the near future.

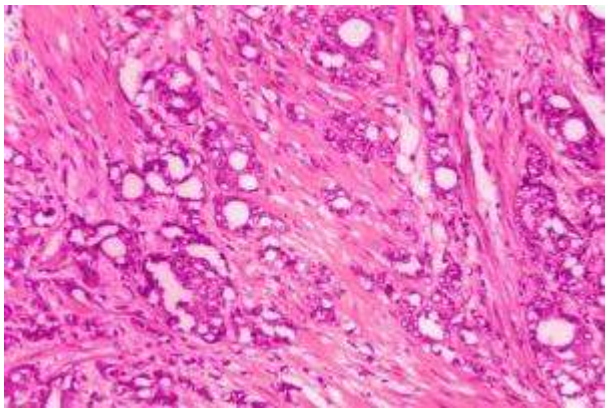
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Karlsruhe Institute of Technology**.

Journal Reference:

1. M. Urdampilleta, S. Klyatskaya, J-P. Cleuziou, M. Ruben, W. Wernsdorfer. **Supramolecular spin valves**. *Nature Materials*, 2011; DOI: 10.1038/nmat3050

http://www.sciencedaily.com/releases/2011/06/110620094900.htm

Human Vaccine Used to Cure Prostate Cancer in Mice



This photomicrograph revealed histopathologic changes indicative of adenocarcinoma, of the prostate. (Credit: CDC/Dr. Edwin P. Ewing, Jr.)

ScienceDaily (June 20, 2011) — Mayo Clinic investigators and collaborators from the United Kingdom cured well-established prostate tumors in mice using a human vaccine with no apparent side effects. This novel cancer treatment approach encourages the immune system to rid itself of prostate tumors without assistance from toxic chemotherapies and radiation treatments. Such a treatment model could some day help people to live tumor free with fewer side effects than those experienced from current therapies.

The findings appear in the journal *Nature Medicine*.

"We are hopeful that this will overcome some of the major hurdles which we have seen with immunotherapy cancer research," says Richard Vile, Ph.D., Mayo Clinic immunologist, Richard M. Schulze Family Foundation Professor and a lead author of the study. Clinical trials could begin within two years.

Mayo's immunotherapy research led by Dr. Vile already shows promise in treating prostate cancer and melanoma. It also is a prime candidate for treatment of many more aggressive cancers, such as lung, brain and pancreatic cancer.

Among the team's findings: no trace of autoimmune diseases in the mice. The murine T-cells attacked only cancerous prostate cells, leaving the healthy tissue unharmed.

To develop this new approach, geneticists assembled snippets of genetic code from healthy human prostate tissue into a complementary DNA (cDNA) library. These bits of cDNA were then inserted into a swarm of vesicular stomatitis viruses (VSV), which were cultured and reintroduced into the test mice as a vaccine during a series of intravenous injections.

Development of comprehensive cDNA libraries from healthy human prostate tissue represents the key to successful immunotherapy. All infections, allergens and tissues, including tumors, have a unique fingerprint called an antigen -- a molecular protein tag that triggers a response from the body's immune system. Dr. Vile deployed the human vaccine prostate cancer antigens through the mutated VSV vector to raise a full-on assault from the mice's T-cells. After exposure to the mutated viruses, the animals' immune systems recognized the antigens expressed in the virus and produced a potent immune response to attack the prostate tumors.

"Nobody really knows how many antigens the immune system can really see on tumor cells," says Dr. Vile. "By expressing all of these proteins in highly immunogenic viruses, we increased their visibility to the immune system. The immune system now thinks it is being invaded by the viruses, which are expressing cancer-related antigens that should be eliminated."

Previous attempts to vaccinate against prostate and other types of cancerous tumors have been hampered largely by researchers' inability to isolate a sufficiently diverse and robust collection of antigens in tumor cells. Because of this, tumors often mutate and re-establish themselves in spite of the body's immune system. The use of viruses as vectors for cDNA libraries overcomes the difficulty of isolating antigens in tumor cells by giving the immune system a more complete picture of the cancerous invader.

This study was a Mayo collaboration with Alan Melcher, Ph.D., and Peter Selby, Ph.D., both from the Cancer Research UK Clinical Centre at St. James' University Hospital and professors at the Leeds Institute of Molecular Medicine, University of Leeds, UK.
Co-authors of the article are: Timothy Kottke; Jose Pulido, M.D.; Feorillo Galivo, Ph.D.; Jill Thompson; Phonphimon Wongthida, Ph.D.; and Rosa Maria Diaz, Ph.D., all of Mayo Clinic; Fiona Errington, Ph.D.; John Chester, Ph.D.; Peter Selby, Ph.D.; and Alan Melcher, Ph.D., all of the Cancer Research UK Clinical Centre, St. James' University Hospital and Leeds Institute of Molecular Medicine, University of Leeds, UK; Heung Chong, Ph.D., of St George's Hospital Medical School, London; Hardev Pandha, Ph.D., of the University of Surrey, Guildford, UK; and Kevin Harrington, Ph.D., of the Institute for Cancer Research, London.
The National Institutes of Health, Cancer Research UK, The Richard M. Schulze Family Foundation, Mayo Clinic, and a private grant funded the study.

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

Journal Reference:

1. Timothy Kottke, Fiona Errington, Jose Pulido, Feorillo Galivo, Jill Thompson, Phonphimon Wongthida, Rosa Maria Diaz, Heung Chong, Elizabeth Ilett, John Chester, Hardev Pandha, Kevin Harrington, Peter Selby, Alan Melcher, Richard Vile. **Broad antigenic coverage induced by vaccination with virus-based cDNA libraries cures established tumors**. *Nature Medicine*, 2011; DOI: 10.1038/nm.2390

http://www.sciencedaily.com/releases/2011/06/110619133456.htm

Arctic Snow Can Harbor Deadly Assassin: Killer Fungal Strains

Tundra. (Credit: © gburba / Fotolia)

ScienceDaily (June 20, 2011) — Heavy and prolonged snowfall can bring about unexpected conditions that encourage fungal growth, leading to the death of plants in the Arctic, according to experts.

A new international study confirms that while snow has an insulating effect which helps plants to grow bigger, heavy and prolonged snow can, in certain circumstances, also encourage the rapid and extensive growth of killer fungal strains.

The research results, published in the journal *Nature Climate Change*, show for the first time the potential long term effects of unexpected fungal development on an arctic landscape. Extensive damage to a pervasive species under snowier conditions would leave gaps for another plant to take its place over time but could also alter the food-web for insects, voles, lemmings and their predators.

Co-author of the report, Dr. Robert Baxter, School of Biological and Biomedical Sciences, Durham University, said: "We were surprised to find that this extremely hardy tundra vegetation was killed off by fungal attack.

"In the first few years, as expected, the insulating effect of the snow helped the vegetation to grow, but after six years a tipping point was reached where the fungus spread with great speed and destroyed the plants.

"We need to look more carefully in the future at longer term vegetation and fungus life cycles to see if this is something that could recur and be more destructive over time."

The research team from Durham University, UK; Umeå University, the Swedish University of Agricultural Sciences, Uppsala, Sweden; and the Finnish Forest Research Institute, compared the effects of normal snowfall conditions and increased snow conditions on vegetation.

Researchers used snow fences to maintain increased snow conditions, and found that the fungus, *Arwidssonia empetri*, increased under heavier and prolonged snow cover killing the majority of the shoots of one of the dominant plant species in that area -- the dwarf shrub *Empetrum hermaphroditum*. The team's unexpected finding followed a decision to keep the experiment running longer than was originally planned.

The researchers believe that the findings highlight unforeseen elements that should be factored into future modelling of the impacts of climate change and its effects on vegetation and food-web chains.

Co-author of the report, Johan Olofsson, Department of Ecology and Environmental Science, Umeå University, Sweden, said: "We set out to look at the effects of climate change and the potential of heavier precipitation and snowfall on plants and the processes that influence growth, decomposition and soil nutrients.

"Shrubs are an important part of the arctic vegetation and we did not expect to find a deadly species-to-species effect influenced by this manipulated snow accumulation."

Snow usually protects arctic plants through the long winter period as it maintains a warmer local environment around the overwintering plants and helps them to grow bigger and faster.

During the seven year experiment, the researchers observed steady plant growth under the protection of the snow's insulating blanket. In year six, the fungus spread rapidly, killing the plant and changing the vegetation from a natural carbon sink to a net carbon source.

Co-author of the report, Lars Ericson, Department of Ecology and Environmental Science, Umeå University, Sweden, said: "We discovered some surprising interactions between plants and other organisms in an area that

is very important for the world's climate. The results will enable us to have a better understanding of longer term climate change effects and extreme weather events, locally and regionally."
The study has been funded by The Natural Environment Research Council, UK; the Centre for Environmental research in Umeå, Sweden; and the Swedish Research Council for the Environment, Agricultural Sciences and Spatial Planning.
The Abisko Scientific Research Station provided accommodation, laboratory facilities and funding during the periods of field work. The research team is continuing the study to investigate the extent and duration of vegetation change under altered snow conditions.

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

Journal Reference:

1. Johan Olofsson, Lars Ericson, Mikaela Torp, Sari Stark, & Robert Baxter. **Carbon Balance of Arctic Tundra Under Increased Snow Cover Mediated by a Plant Pathogen**. *Nature Climate Change*, June 19, 2011 DOI: 10.1038/nclimate1142

http://www.sciencedaily.com/releases/2011/06/110619133515.htm

Glimpsing the End of Our Solar System

A Hubble Space Telescope color image of a small portion of the cluster only 0.63 light-years across reveals eight white dwarf stars (inside blue circles) among the cluster's much brighter population of yellow sun-like stars and cooler red dwarf stars. (Credit: Harvey Richer (University of British Columbia, Vancouver, Canada) and NASA)

ScienceDaily (June 20, 2011) — Researchers at the University of Leicester are investigating the possible eventual fate of the solar system by examining 'white dwarf' stars elsewhere in our galaxy.

A white dwarf is the last stage in the life cycle of a star like the Sun, after it has contracted to a diameter smaller than that of Earth. Incredibly dense, one teaspoon of white dwarf material would weigh about five tonnes.

Nathan Dickinson, a postgraduate student in the University's Department of Physics and Astronomy, is researching the chemical composition of white dwarfs for his PhD. He is particularly interested in the presence of 'heavy elements' in and around white dwarfs, which are otherwise mainly composed of the two simplest elements, hydrogen and helium.

Data from the Hubble Space Telescope provides a spectrum for each star which reveals its chemical make-up. Older, cooler white dwarfs, with a temperature of less than 25,000 degrees, sometimes contain elements such as oxygen, nitrogen, silicon and iron which have been 'hoovered up' from the remains of planets.

Younger, hotter white dwarfs, above that temperature always show heavy chemicals due to their high temperature. However, they sometimes exhibit more of this material than is expected, which raises the question of whether this extra material also came from planets or whether it originated elsewhere, perhaps in clouds around the star."

"Understanding whether the extra material in hot white dwarfs comes from torn up planets is important," emphasizes Dickinson. "It can give us an idea of how these ancient planetary systems evolve as the star ages, so we get a fuller picture of how solar systems die.

"Being the end point of the life cycles of most stars, white dwarfs are among the oldest objects in the galaxy, so they can tell us about what were in the oldest solar systems. Given that the Sun will end its life as a white dwarf, this could tell us what could ultimately happen to our solar system."

In 2010 Dickinson presented some of his work at the 17th European White Dwarf Workshop in Germany, which has since been published in the journal *AIP Conference Proceedings*.

"Working at the forefront of this scientific area is extremely exciting," says Dickinson. "I find being one of a relatively small community of people in the world to work on this particular area amazing. This work is helping to shape our understanding of how most stars end their lives, how solar systems die, how the environment around these ancient stars behaves and what will ultimately happen to the vast majority of stars in the galaxy.
Pro Vice Chancellor and Head of the College of Science and Engineering, Professor Martin Barstow added: "These are important results which show how younger scientists can be involved in cutting edge research and help the University make important contributions to answering some of the most challenging questions about the Universe and our place within it."

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

Journal Reference:

1. N. J. Dickinson, M. A. Barstow, I. Hubeny, Klaus Werner, T. Rauch. **The Stratification of Metals in Hot White Dwarf Atmospheres**. , DOI: 10.1063/1.3527850

http://www.sciencedaily.com/releases/2011/06/110617080839.htm

Green Ring Fit for a Superhero: Spitzer Space Telescope Spies Powerful Light of Giant 'O' Stars

This glowing emerald nebula seen by NASA's Spitzer Space Telescope is reminiscent of the glowing ring wielded by the superhero Green Lantern. (Credit: NASA/JPL-Caltech)

ScienceDaily (June 19, 2011) — This glowing emerald nebula seen by NASA's Spitzer Space Telescope is reminiscent of the glowing ring wielded by the superhero Green Lantern. In the comic books, the diminutive Guardians of the Planet "Oa" forged his power ring, but astronomers believe rings like this are actually sculpted by the powerful light of giant "O" stars. O stars are the most massive type of star known to exist.

Named RCW 120 by astronomers, this region of hot gas and glowing dust can be found in the murky clouds encircled by the tail of the constellation Scorpius. The green ring of dust is actually glowing in infrared colors that our eyes cannot see, but show up brightly when viewed by Spitzer's infrared detectors. At the center of this ring are a couple of giant stars whose intense ultraviolet light carved out the bubble, though they blend in with the other stars when viewed in infrared.

Rings like this are so common in Spitzer's observations that astronomers have even enlisted the help of the public to help find and catalog them all. Anyone interested in joining the search as a citizen scientist can visit "The Milky Way Project," part of the "Zooniverse" of public astronomy projects, at http://www.milkywayproject.org/ .

The flat plane of our galaxy is located toward the bottom of the picture, and the ring is slightly above the plane. The green haze seen at the bottom of the image is the diffuse glow of dust from the galactic plane. NASA's Jet Propulsion Laboratory, Pasadena, Calif., manages the Spitzer Space Telescope mission for NASA's Science Mission Directorate, Washington. Science operations are conducted at the Spitzer Science

Center at the California Institute of Technology in Pasadena. Caltech manages JPL for NASA. For more information about Spitzer, visit http://spitzer.caltech.edu/ and http://www.nasa.gov/spitzer

Story Source:
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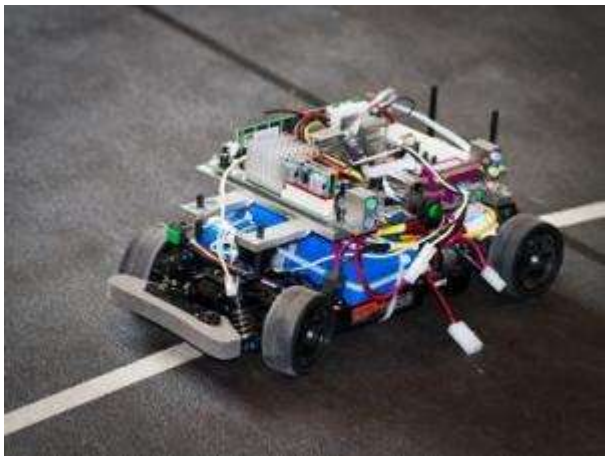
http://www.sciencedaily.com/releases/2011/06/110619140505.htm

Intelligent Onboard Transportation Systems to Prevent Car Crashes?



The researchers test their algorithm using a miniature autonomous vehicle traveling along a track that partially overlaps with a second track for a human-controlled vehicle, observing incidences of collision and collision avoidance. (Credit: Melanie Gonick)

ScienceDaily (June 19, 2011) — Since 2000, there have been 110 million car accidents in the United States, more than 443,000 of which have been fatal -- an average of 110 fatalities per day. These statistics make traffic accidents one of the leading causes of death in this country, as well as worldwide.

Engineers have developed myriad safety systems aimed at preventing collisions: automated cruise control, a radar- or laser-based sensor system that slows a car when approaching another vehicle; blind-spot warning systems, which use lights or beeps to alert the driver to the presence of a vehicle he or she can't see; and traction control and stability assist, which automatically apply the brakes if they detect skidding or a loss of steering control.

Still, more progress must be made to achieve the long-term goal of "intelligent transportation": cars that can "see" and communicate with other vehicles on the road, making them able to prevent crashes virtually 100 percent of the time.

Of course, any intelligent transportation system (ITS), even one that becomes a mainstream addition to new cars, will have to contend with human-operated vehicles as long as older cars remain on the road -- that is, for the foreseeable future. To this end, MIT mechanical engineers are working on a new ITS algorithm that takes into account models of human driving behavior to warn drivers of potential collisions, and ultimately takes control of the vehicle to prevent a crash.

The theory behind the algorithm and some experimental results will be published in the journal *IEEE Robotics and Automation Magazine*. The paper is co-authored by Rajeev Verma, who was a visiting PhD student at MIT this academic year, and Domitilla Del Vecchio, assistant professor of mechanical engineering and W. M. Keck Career Development Assistant Professor in Biomedical Engineering.

Avoiding the car that cried wolf

According to Del Vecchio, a common challenge for ITS developers is designing a system that is safe without being overly conservative. It's tempting to treat every vehicle on the road as an "agent that's playing against you," she says, and construct hypersensitive systems that consistently react to worst-case scenarios. But with this approach, Del Vecchio says, "you get a system that gives you warnings even when you don't feel them as necessary. Then you would say, 'Oh, this warning system doesn't work,' and you would neglect it all the time."

That's where predicting human behavior comes in. Many other researchers have worked on modeling patterns of human driving. Following their lead, Del Vecchio and Verma reasoned that driving actions fall into two main modes: braking and accelerating. Depending on which mode a driver is in at a given moment, there is a finite set of possible places the car could be in the future, whether a tenth of a second later or a full 10 seconds later. This set of possible positions, combined with predictive models of human behavior -- when and where drivers slow down or speed up around an intersection, for example -- all went into building the new algorithm.

The result is a program that is able to compute, for any two vehicles on the road nearing an intersection, a "capture set," or a defined area in which two vehicles are in danger of colliding. The ITS-equipped car then engages in a sort of game-theoretic decision, in which it uses information from its onboard sensors as well as roadside and traffic-light sensors to try to predict what the other car will do, reacting accordingly to prevent a crash.

When both cars are ITS-equipped, the "game" becomes a cooperative one, with both cars communicating their positions and working together to avoid a collision.

Steering clear of the 'bad set'

Del Vecchio and Verma tested their algorithm with a laboratory setup involving two miniature vehicles on overlapping circular tracks: one autonomous and one controlled by a human driver. Eight volunteers participated, to account for differences in individual driving styles. Out of 100 trials, there were 97 instances of collision avoidance. The vehicles entered the capture set three times; one of these times resulted in a collision.

In the three "failed" trials, Del Vecchio says the trouble was largely due to delays in communication between ITS vehicles and the workstation, which represents the roadside infrastructure that captures and transmits information about non-ITS-equipped cars. In these cases, one vehicle may be making decisions based on information about the position and speed of the other vehicle that is off by a fraction of a second. "So you may end up actually being in the capture set while the vehicles think you are not," Del Vecchio says.

One way to handle this problem is to improve the communication hardware as much as possible, but the researchers say there will virtually always be delays, so their next step is to make the system robust to these delays -- that is, to ensure that the algorithm is conservative enough to avoid a situation in which a communication delay could mean the difference between crashing and not crashing.

Jim Freudenberg, a professor of electrical and computer engineering at the University of Michigan, says that although it's nearly impossible to correctly predict human behavior 100 percent of the time, Del Vecchio and Verma's approach is promising. "Human-controlled technologies and computer-controlled technologies are coming more and more into contact with one other, and we have to have some way of making assumptions about the human -- otherwise, you can't do anything because of how conservative you have to be," he says.

The researchers have already begun to test their system in full-size passenger vehicles with human drivers. In addition to learning from these real-life trials, future work will focus on incorporating human reaction-time data to refine when the system must actively take control of the car and when it can merely provide a passive warning to the driver.

Eventually, the researchers also hope to build in sensors for weather and road conditions and take into account car-specific manufacturing details -- all of which affect handling -- to help their algorithm make even better informed decisions.

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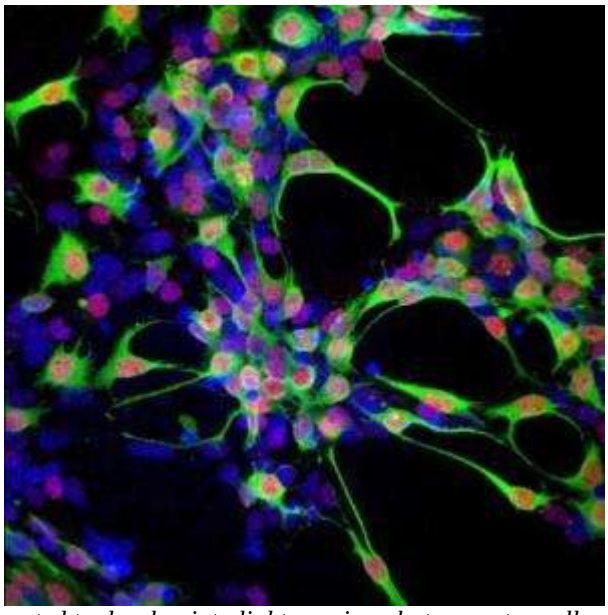
Progress Using Induced Pluripotent Stem Cells to Reverse Blindness



Human-induced pluripotent stem (iPS) cells can be directed to develop into light-sensing photoreceptor cells of the retina. It is hoped that these cells can be used to better understand and treat human disease affecting the visual system. (Credit: Jason Meyer, Ph.D., School of Science at Indiana University-Purdue University Indianapolis)

ScienceDaily (June 18, 2011) — Researchers have used cutting-edge stem cell technology to correct a genetic defect present in a rare blinding disorder, another step on a promising path that may one day lead to therapies to reverse blindness caused by common retinal diseases such as macular degeneration and retinitis pigmentosa which affect millions of individuals.

In a study appearing in an advance online publication of the journal *Stem Cells* on June 15, 2011, investigators used recently developed technology to generate induced pluripotent stem (iPS) cells from a human patient with an uncommon inherited eye disease known as gyrate atrophy. This disorder affects retinal pigment epithelium (RPE) cells, the cells critical to the support of the retina's photoreceptor cells, which function in the transmission of messages from the retina to parts of the brain that interpret images.

"When we generate iPS cells, correct the gene defect that is responsible for this disease, and guide these stem cells to become RPE cells, these RPE cells functioned normally. This is exciting because it demonstrates we can fix something that is out of order. It also supports our belief that in the future, one might be able to use this approach for replacement of cells lost or malfunctioning due to other more common diseases of the retina," said lead study author cell biologist Jason Meyer, Ph.D., assistant professor of biology in the School of Science at Indiana University-Purdue University Indianapolis.

Macular degeneration is the most common cause of blindness, affecting an estimated 25-30 million people worldwide. One and a half million people worldwide are affected by retinitis pigmentosa.

Because iPS cells can be derived from the specific patient who needs them, use of these cells may avoid the problem of transplant rejection. In the study, vitamin B-6 also was used to treat the damaged RPE cells producing healthy cells that functioned normally. The retina is a relatively easily accessible part of the central nervous system, which makes it an attractive target for correction with iPS cells. Researchers are hopeful that once the gene defect responsible for a blinding disorder is corrected in iPS cells, these cells may be able to restore vision.

In addition to Meyer of the School of Science at IUPUI, "Optic Vesicle-like Structures Derived from Human Pluripotent Stem Cells Facilitate a Customized Approach to Retinal Disease Treatment" is co-authored by Sara E. Howden, Kyle A. Wallace, Amelia D. Verhoeven, Lynda S. Wright, Elizabeth E. Capowski, Jessica M. Martin, Shulan Tian, Ron Stewart, Bikash Pattnaik, James Thomson and David M. Gamm, all of the University of Wisconsin; and Isabel Pinilla of Blesa University Hospital and the Instituto Aragones de

Ciencias de la Salud in Spain. Meyer is also a primary investigator with the Stark Neurosciences Research Institute at Indiana University School of Medicine. Thomson is also associated with the University of California -- Santa Barbara.

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

Journal Reference:

1. Jason S. Meyer, Sara E. Howden, Kyle A. Wallace, Amelia D. Verhoeven, Lynda S. Wright, Elizabeth E. Capowski, Isabel Pinilla, Jessica M. Martin, Shulan Tian, Ron Stewart, Bikash Pattnaik, James Thomson, David M. Gamm. **Optic Vesicle-like Structures Derived from Human Pluripotent Stem Cells Facilitate a Customized Approach to Retinal Disease Treatment**. *Stem Cells*, 2011; DOI: 10.1002/stem.674

http://www.sciencedaily.com/releases/2011/06/110615120248.htm

Dawn of Agriculture Took Toll On Health

Amanda Mummert led the first comprehensive, global review of the literature regarding stature and health during the agriculture transition. (Credit: Image courtesy of Emory University)

ScienceDaily (June 18, 2011) — When populations around the globe started turning to agriculture around 10,000 years ago, regardless of their locations and type of crops, a similar trend occurred: The height and health of the people declined.

"This broad and consistent pattern holds up when you look at standardized studies of whole skeletons in populations," says Amanda Mummert, an Emory graduate student in anthropology.

Mummert led the first comprehensive, global review of the literature regarding stature and health during the agriculture transition, to be published by the journal *Economics and Human Biology*.

"Many people have this image of the rise of agriculture and the dawn of modern civilization, and they just assume that a more stable food source makes you healthier," Mummert says. "But early agriculturalists experienced nutritional deficiencies and had a harder time adapting to stress, probably because they became dependent on particular food crops, rather than having a more significantly diverse diet."

She adds that growth in population density spurred by agriculture settlements led to an increase in infectious diseases, likely exacerbated by problems of sanitation and the proximity to domesticated animals and other novel disease vectors.

Eventually, the trend toward shorter stature reversed, and average heights for most populations began increasing. The trend is especially notable in the developed world during the past 75 years, following the industrialization of food systems.

"Culturally, we're agricultural chauvinists. We tend to think that producing food is always beneficial, but the picture is much more complex than that," says Emory anthropologist George Armelagos, co-author of the

review. "Humans paid a heavy biological cost for agriculture, especially when it came to the variety of nutrients. Even now, about 60 percent of our calories come from corn, rice and wheat."
In 1984, Armelagos and M. N. Cohen wrote the book, "Paleopathology at the Origins of Agriculture," which drew from more than 20 studies to describe an increase in declining health and nutritional diseases as societies shifted from foraging to agriculture.
The book was controversial at the time, but the link between the agricultural transition and declining health soon became widely accepted in what was then the emerging field of bioarcheology.
The current review was undertaken to compare data from more recent studies involving different world regions, crops and cultures. The studies included populations from areas of China, Southeast Asia, North and South America and Europe. All of the papers used standardized methods for assessing health at the individual level and examined how stressors were exhibited within the entire skeleton, rather than a concentration on a particular skeletal element or condition.
"Unless you're considering a complete skeleton, you're not getting a full picture of health," Mummert says. "You could have an individual with perfect teeth, for example, but serious markers of infection elsewhere. You could see pitting on the skull, likely related to anemia or nutritional stress, but no marks at all on the long bones."
Adult height, dental cavities and abscesses, bone density and healed fractures are some of the markers used to try to paint a more complete picture of an individual's health.
"Bones are constantly remodeling themselves," Mummert says. "Skeletons don't necessarily tell you what people died of, but they can almost always give you a glimpse into their ability to adapt and survive."
While the review further supports the link between early agricultural practices and declining stature and health, it's important to keep re-evaluating the data as more studies are completed, Mummert says.
One confounding factor is that agriculture was not adopted in an identical fashion and time span across the globe. In some ancient societies, such as those of the North American coasts, crops may have merely supplemented a seafood diet. "In these cases, a more sedentary lifestyle, and not necessarily agriculture, could have perpetuated decreased stature," Mummert says.
The way the human body adapted to changes we made in the environment 10,000 years ago could help us understand how our bodies are adapting now, she says.
Some economists and other scientists are using the rapid physiological increases in human stature during the 20th century as a key indicator of better health.
"I think it's important to consider what exactly 'good health' means," Mummert says. "The modernization and commercialization of food may be helping us by providing more calories, but those calories may not be good for us. You need calories to grow bones long, but you need rich nutrients to grow bones strong."

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

Journal Reference:

1. Amanda Mummert, Emily Esche, Joshua Robinson and George J. Armelagos. **Stature and robusticity during the agricultural transition: Evidence from the bioarchaeological record**. *Economics & Human Biology*, Volume 9, Issue 3, July 2011, Pages 284-301

http://www.sciencedaily.com/releases/2011/06/110615094514.htm

Spectacular Hubble View of Centaurus A

Centaurus A, also known as NGC 5128, is well known for its dramatic dusty lanes of dark material. Hubble's new observations, using its most advanced instrument, the Wide Field Camera 3, are the most detailed ever made of this galaxy. They have been combined here in a multi-wavelength image which reveals never-before-seen detail in the dusty portion of the galaxy. As well as features in the visible spectrum, this composite shows ultraviolet light, which comes from young stars, and near-infrared light, which lets us glimpse some of the detail otherwise obscured by the dust. (Credit: NASA, ESA, and the Hubble Heritage (STScI/AURA)-ESA/Hubble Collaboration. Acknowledgment: R. O'Connell (University of Virginia) and the WFC3 Scientific Oversight Committee)

ScienceDaily (June 17, 2011) — The NASA/ESA Hubble Space Telescope has produced a close-up view of the galaxy Centaurus A. Hubble's out-of-this-world location and world-class Wide Field Camera 3 instrument reveal a dramatic picture of a dynamic galaxy in flux.

Centaurus A, also known as NGC 5128, is well known for its dramatic dusty lanes of dark material. Hubble's observations, using its most advanced instrument, the Wide Field Camera 3, are the most detailed ever made of this galaxy. They have been combined here in a multi-wavelength image that reveals never-before-seen detail in the dusty portion of the galaxy.

As well as features in the visible spectrum, this composite shows ultraviolet light from young stars, and near-infrared light, which lets us glimpse some of the detail otherwise obscured by the dust.

The dark dust lane that crosses Centaurus A does not show an absence of stars, but rather a relative lack of starlight, as the opaque clouds block the visible light from reaching us. Hubble's Wide Field Camera 3 has focussed on these dusty regions, which span from corner to corner in this image. Wider views from ground-based telescopes show this stripe crossing the entire galaxy.

Interesting features such as the warped shape of its disc of gas and dust (outside the view) hint that at some point in the past, Centaurus A collided and merged with another galaxy. The shockwaves of this event caused hydrogen gas to coalesce and sparked intense areas of star formation, as seen in its outlying regions and in red patches visible in this Hubble close-up.

The galaxy's compact nucleus contains a highly active supermassive black hole at its centre. Powerful relativistic jets release vast amounts of radio and X-ray radiation -- although these are invisible here as Hubble's instruments are designed to study optical, ultraviolet and infrared wavelengths.

At just over 11 million light-years distant, Centaurus A is relatively nearby in astronomical terms. However, it is not only close, it is also bright. This makes it a very attractive target for amateur astronomers in the southern hemisphere, where it is visible. Stargazers can see the galaxy through binoculars, while larger amateur telescopes begin to unveil the distinctive dusty lanes.

However it is only with the capabilities of the Hubble Space Telescope that many of the features in this image become visible: as well as providing unparalleled clarity and resolution, Hubble's position in orbit means that it can see ultraviolet wavelengths which are blocked by the atmosphere and so invisible from the ground.

Story Source:
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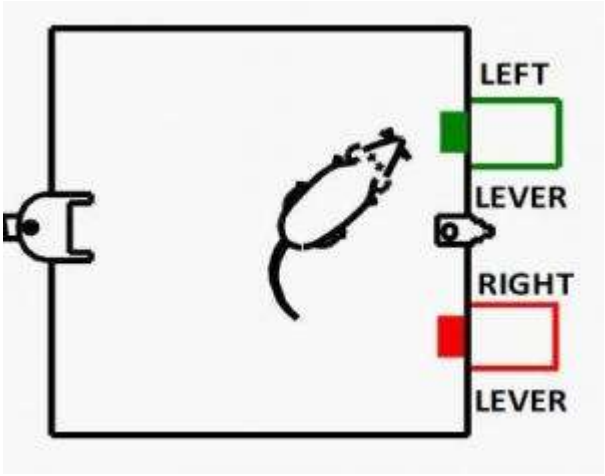
http://www.sciencedaily.com/releases/2011/06/110616092645.htm

Scientists Turn Memories Off and On With Flip of Switch



In the experiment, the researchers had rats learn a task, pressing one lever rather than another to receive a reward. Using embedded electrical probes, the experimental research team recorded changes in the rat's brain activity between the two major internal divisions of the hippocampus, known as subregions CA3 and CA1. The experimenters then blocked the normal neural interactions between the two areas using pharmacological agents. The previously trained rats then no long displayed the long-term learned behavior. But long-term memory capability returned to the pharmacologically blocked rats when the team activated the electronic device programmed to duplicate the memory-encoding function. (Credit: USC Viterbi School of Engineering)

ScienceDaily (June 17, 2011) — Scientists have developed a way to turn memories on and off -- literally with the flip of a switch. Using an electronic system that duplicates the neural signals associated with memory, they managed to replicate the brain function in rats associated with long-term learned behavior, even when the rats had been drugged to forget.

"Flip the switch on, and the rats remember. Flip it off, and the rats forget," said Theodore Berger of the USC Viterbi School of Engineering's Department of Biomedical Engineering.

Berger is the lead author of an article that will be published in the *Journal of Neural Engineering*. His team worked with scientists from Wake Forest University in the study, building on recent advances in our understanding of the brain area known as the hippocampus and its role in learning.

In the experiment, the researchers had rats learn a task, pressing one lever rather than another to receive a reward. Using embedded electrical probes, the experimental research team, led by Sam A. Deadwyler of the Wake Forest Department of Physiology and Pharmacology, recorded changes in the rat's brain activity between the two major internal divisions of the hippocampus, known as subregions CA3 and CA1. During the learning process, the hippocampus converts short-term memory into long-term memory, the researchers prior work has shown.

"No hippocampus," says Berger, "no long-term memory, but still short-term memory." CA3 and CA1 interact to create long-term memory, prior research has shown.

In a dramatic demonstration, the experimenters blocked the normal neural interactions between the two areas using pharmacological agents. The previously trained rats then no longer displayed the long-term learned behavior.

"The rats still showed that they knew 'when you press left first, then press right next time, and vice-versa,'" Berger said. "And they still knew in general to press levers for water, but they could only remember whether they had pressed left or right for 5-10 seconds."

Using a model created by the prosthetics research team led by Berger, the teams then went further and developed an artificial hippocampal system that could duplicate the pattern of interaction between CA3-CA1 interactions.

Long-term memory capability returned to the pharmacologically blocked rats when the team activated the electronic device programmed to duplicate the memory-encoding function.

In addition, the researchers went on to show that if a prosthetic device and its associated electrodes were implanted in animals with a normal, functioning hippocampus, the device could actually strengthen the memory being generated internally in the brain and enhance the memory capability of normal rats.
"These integrated experimental modeling studies show for the first time that with sufficient information about the neural coding of memories, a neural prosthesis capable of real-time identification and manipulation of the encoding process can restore and even enhance cognitive mnemonic processes," says the paper.
Next steps, according to Berger and Deadwyler, will be attempts to duplicate the rat results in primates (monkeys), with the aim of eventually creating prostheses that might help the human victims of Alzheimer's disease, stroke or injury recover function.
The paper is entitled "A Cortical Neural Prosthesis for Restoring and Enhancing Memory." Besides Deadwyler and Berger, the other authors are, from USC, BME Professor Vasilis Z. Marmarelis and Research Assistant Professor Dong Song, and from Wake Forest, Associate Professor Robert E. Hampson and Post-Doctoral Fellow Anushka Goonawardena.
Berger, who holds the David Packard Chair in Engineering, is the Director of the USC Center for Neural Engineering, Associate Director of the National Science Foundation Biomimetic MicroElectronic Systems Engineering Research Center, and a Fellow of the IEEE, the AAAS, and the AIMBE
"A Cortical Neural Prosthesis for Restoring and Enhancing Memory." (Berger et al 2011 J. Neural Eng. 8 046017)

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Stretchable Electronics: Wireless Sensor Measures and Inputs Intense Body Movements to Computer

The stretchable antenna that wireless transmits information to a computer open the door for new and exciting applications that previously only been seen in movie theaters. (Credit: Andreas Dahlin)

ScienceDaily (June 17, 2011) — Electronics that can be bent and stretched might sound like science fiction. But Uppsala researcher Zhigang Wu, working with collaborators, has devised a wireless sensor that can stand to be stretched. For example, the sensor can measure intensive body movements and wirelessly send information directly to a computer.

The findings are now being presented in the journal *Advanced Functional Materials.*

Robots of liquid metal, as in the Terminator movies, are probably the best-known cases of deformable electronic systems. But so far this only exists in our imagination. Twisting, folding, and stretching fragile conventional electronics is not yet possible.

The latest advances in the field of µFSRFE (microfluidic stretchable radio frequency electronics) have shown the possibility of combining established stiff electronics components with channels of elastomers filled with fluid metal. In this way it has been possible to construct systems that after severe mechanical deformation can manage to return to their original form. Such electronics can adapt to nearly any bent and moving surfaces on a human being or a robot and can thus serve as a second layer of smart e-skin for health monitoring or remote control.

The researcher Zhigang Wu from Uppsala University, in collaboration with researchers at the company Laird Technologies, has presented a newly developed and wireless µFSRFE sensor consisting of a multifunctional antenna integrated with a conventional rigid circuit board. The reporting sensor can measure intensive body movements and wirelessly send information directly to a computer. The design enables wireless measurement of repeated bending across a large area or moveable parts.

The sensor they designed will pave the way for myriad new applications that until now have only been seen on the movie screen.

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

Journal Reference:

1. Shi Cheng, Zhigang Wu. **A Microfluidic, Reversibly Stretchable, Large-Area Wireless Strain Sensor**. *Advanced Functional Materials*, 2011; DOI: 10.1002/adfm.201002508

http://www.sciencedaily.com/releases/2011/06/110616092540.htm

Noninvasive Brain Implant Could Someday Translate Thoughts Into Movement

A brain implant developed at the University of Michigan uses the body's skin like a conductor to wirelessly transmit the brain's neural signals to control a computer, and may eventually be used to reactivate paralyzed limbs. (Credit: Photo provided by Euisik Yoon of University of Michigan)

ScienceDaily (June 17, 2011) — A brain implant developed at the University of Michigan uses the body's skin like a conductor to wirelessly transmit the brain's neural signals to control a computer, and may eventually be used to reactivate paralyzed limbs.

The implant is called the BioBolt, and unlike other neural interface technologies that establish a connection from the brain to an external device such as a computer, it's minimally invasive and low power, said principal investigator Euisik Yoon, a professor in the U-M College of Engineering, Department of Electrical Engineering and Computer Science.

Currently, the skull must remain open while neural implants are in the head, which makes using them in a patient's daily life unrealistic, said Kensall Wise, the William Gould Dow Distinguished University professor emeritus in engineering.

BioBolt does not penetrate the cortex and is completely covered by the skin to greatly reduce risk of infection. Researchers believe it's a critical step toward the Holy Grail of brain-computer interfacing: allowing a paralyzed person to "think" a movement.

"The ultimate goal is to be able to reactivate paralyzed limbs," by picking the neural signals from the brain cortex and transmitting those signals directly to muscles, said Wise, who is also founding director of the NSF Engineering Research Center for Wireless Integrated MicroSystems (WIMS ERC). That technology is years away, the researchers say.

Another promising application for the BioBolt is controlling epilepsy, and diagnosing certain diseases like Parkinson's.

The concept of BioBolt is filed for patent and was presented on June 16 at the 2011 Symposium on VLSI Circuits in Kyoto, Japan. Sun-Il Chang, a PhD student in Yoon's research group, is lead author on the presentation.

The BioBolt looks like a bolt and is about the circumference of a dime, with a thumbnail-sized film of microcircuits attached to the bottom. The BioBolt is implanted in the skull beneath the skin and the film of

microcircuits sits on the brain. The microcircuits act as microphones to 'listen' to the overall pattern of firing neurons and associate them with a specific command from the brain. Those signals are amplified and filtered, then converted to digital signals and transmitted through the skin to a computer, Yoon said.
Another hurdle to brain interfaces is the high power requirement for transmitting data wirelessly from the brain to an outside source. BioBolt keeps the power consumption low by using the skin as a conductor or a signal pathway, which is analogous to downloading a video into your computer simply by touching the video. Eventually, the hope is that the signals can be transmitted through the skin to something on the body, such as a watch or a pair of earrings, to collect the signals, said Yoon, eliminating the need for an off-site computer to process the signals.

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