

<http://bit.ly/1sFTk6m>

## Denmark claims North Pole via Greenland ridge link

*Scientific data shows Greenland's continental shelf is connected to a ridge beneath the Arctic Ocean, giving Danes a claim to the North Pole and any potential energy resources beneath it, Denmark's foreign minister said.*

By Jan M. Olsen in Earth / Earth Sciences

Foreign Minister Martin Lidegaard said Denmark will deliver a claim on Monday to a United Nations panel in New York that will eventually decide control of the area, which Russia and Canada are also coveting.

The five Arctic countries—the United States, Russia, Norway, Canada and Denmark—all have areas surrounding the North Pole, but only Canada and Russia had indicated an interest in it before Denmark's claim.

Lidegaard told the AP that the Arctic nations so far "have stuck to the rules of the game" and he hoped they would continue to do so.

In 2008, the five pledged that control of the North Pole region would be decided in an orderly settlement in the framework of the United Nations, and possible overlapping claims would be dealt with bilaterally.

Interest in the Arctic is intensifying as global warming shrinks the polar ice, opening up possible resource development and new shipping lanes.

The area is believed to hold an estimated 13 percent of the world's undiscovered oil and 30 percent of its untapped gas.

Lidegaard said he expects no quick decisions, with other countries also sending in claims.

"This is a historical milestone for Denmark and many others as the area has an impact on the lives of a lot of people. After the U.N. panel had taken a decision based on scientific data, comes a political process," Lidegaard told The Associated Press in an interview on Friday. "I expect this to take some time. An answer will come in a few decades."

Between 2007 and 2012, Danish scientists with colleagues from Canada, Sweden and Russia surveyed a 2,000-kilometer- (1,240-mile-) long underwater mountain range that runs north of Siberia concluding that Greenland, a sparsely populated huge island that is a semi-autonomous Danish territory, is geologically attached to the ridge.

That prompted Danes to claim the right to exploit an area of 895,000 square kilometers (345,600 square miles).

"The Lomonosov ridge is the natural extension of the Greenland shelf," said Christian Marcussen, a senior geophysicist with the Geological Survey of Denmark and Greenland. "Coincidentally, the North Pole which is a tiny, tiny abstract spot lies in the area."

<http://phys.org/news/2014-12-habitual-told-cave-haifa.html>

## Habitual use of fire as told from cave near Haifa

*Expanded timeline as to when we transitioned from occasional use to habitual, planned use of fire*

by Nancy Owano in Other Sciences / Archaeology & Fossils

Scientists have not been content with the exercise of dating when man first used fire. While the earliest evidence for hominin use of fire dates to more than a million years ago, scientists have been keen to explore an expanded timeline as to when we transitioned from occasional use to habitual, planned use of fire. A research effort by a team of scientists has turned up evidence and they have written what they understand about a time frame of a 'technological mutation.' That in turn can help explain our evolution and "encephalization."

Their study, ['Fire at will': The emergence of habitual fire use 350,000 years ago](#), is published in this month's Journal of Evolution. Their study suggests, as stated in a publication of the Archeological Institute of America, Archaeology, that human ancestors regularly began using fire some 350,000 years ago. The six authors studied flint tools recovered from Israel's Tabun Cave. The authors are from the Zinman Institute of Archaeology, University of Haifa, and School of Anthropology, University of Arizona.

They uncovered burnt flint material from a 16-m-deep sequence of archaeological deposits at Tabun Cave, near Haifa, Israel. According to a report in Science, the Tabun Cave is a site with a long sequence. In turn, said Ron Shimelmitz, archaeologist at the University of Haifa and study co-author, they were able to explore, step by step, how the use of fire changed in the cave. Shimelmitz also said in the Science report that the findings were consistent with data from several nearby sites.

The authors wrote that "burnt artifacts are found not only within hearths but also scattered throughout the general area of excavations, a result of processes such as cleaning out of fireplaces, trampling and earth moving." They said that "the frequency of burnt flints should be a suitable proxy for the frequency of fires within the cave." Since the stone is so durable, burnt flints are not expected to suffer from the same degree of post-depositional alteration and destruction as are hearth features, heated sediments, charcoal and ash or even burnt bones, they added.

Two factors, the flint discoveries along with data from a Levantine archaeological record, demonstrated that "regular or habitual fire use developed in the region between 350,000–320,000 years ago. While hominins may have used fire occasionally, perhaps opportunistically, for some million years, we argue here that it only became a consistent element in behavioral adaptations during the second

part of the Middle Pleistocene." They concluded that "Fire became a regular part of hominin behavior during the second half of the Middle Pleistocene."

The value of their research is in its contribution to reconstructing features of evolutionary history, including changes in anatomy and dispersal of hominins into temperate regions. Ilan Ben Zion, news editor at The Times of Israel, explained that examination of the strata in the cave found that, before roughly 350,000 years ago, "few of the stones showed signs of exposure to intense heat. After that point, an increasing number show signs of red or black coloration, cracking, and small round depressions typical of exposure to fire."

In their study, the authors said that, "We suggest that the changes in burning frequency at Tabun and Qesem not only signal the point in time where the use of fire became habitual, but also indicate that humans had mastered the art of kindling fire. Unfortunately there are no means currently available to directly determine how ancient fires were started, so the latter remains simply a hypothesis for the time being."

More information: 'Fire at will': The emergence of habitual fire use 350,000 years ago, *Journal of Human Evolution*, Volume 77, December 2014, Pages 196–203.

[www.sciencedirect.com/science/.../ii/S0047248414001778](http://www.sciencedirect.com/science/.../ii/S0047248414001778)

<http://bit.ly/13kJQqB>

## **MESSENGER data suggest recurring meteor shower on Mercury**

*The closest planet to the sun appears to get hit by a periodic meteor shower, possibly associated with a comet that produces multiple events annually on Earth.*

Dec 15, 2014 by Nancy Neal-Jones

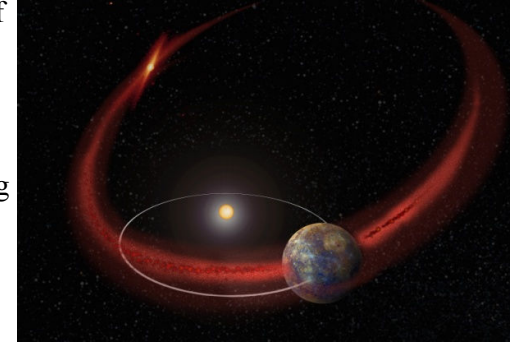
The clues pointing to Mercury's shower were discovered in the very thin halo of gases that make up the planet's exosphere, which is under study by NASA's MESSENGER (MErcury Surface, Space ENvironment, GEOchemistry, and Ranging) spacecraft.

"The possible discovery of a meteor shower at Mercury is really exciting and especially important because the plasma and dust environment around Mercury is relatively unexplored," said Rosemary Killen, a planetary scientist at NASA's Goddard Space Flight Center in Greenbelt, Maryland, and lead author of the study, available online in *Icarus*.

A meteor shower occurs when a planet passes through a swath of debris shed by a comet, or sometimes an asteroid. The smallest bits of dust, rock and ice feel the force of solar radiation, which pushes them away from the sun, creating the comet's sometimes-dazzling tail. The larger chunks get deposited like a trail of breadcrumbs along the comet's orbit – a field of tiny meteoroids in the making.

Earth experiences multiple meteor showers each year, including northern summer's Perseids, the calling card of comet Swift–Tuttle, and December's reliable Geminids, one of the few events associated with an asteroid.

Comet Encke has left several debris fields in the inner solar system, giving rise to the Southern and Northern Taurids, meteor showers that peak in October and November, and the Beta Taurids in June and July.



*Mercury appears to undergo a recurring meteor shower, perhaps when its orbit crosses the debris trail left by comet Encke. (Artist's concept.) NASA's Goddard Space Flight Center*

The suggested hallmark of a meteor shower on Mercury is a regular surge of calcium in the exosphere. Measurements taken by MESSENGER's Mercury Atmospheric and Surface Composition Spectrometer have revealed seasonal surges of calcium that occurred regularly over the first nine Mercury years since MESSENGER began orbiting the planet in March 2011.

The suspected cause of these spiking calcium levels is a shower of small dust particles hitting the planet and knocking calcium-bearing molecules free from the surface. This process, called impact vaporization, continually renews the gases in Mercury's exosphere as interplanetary dust and meteoroids rain down on the planet. However, the general background of interplanetary dust in the inner solar system cannot, by itself, account for the periodic spikes in calcium. This suggests a periodic source of additional dust, for example, a cometary debris field.

Examination of the handful of comets in orbits that would permit their debris to cross Mercury's orbit indicated that the likely source of the planet's event is Encke. "If our scenario is correct, Mercury is a giant dust collector," said Joseph Hahn, a planetary dynamist in the Austin, Texas, office of the Space Science Institute and coauthor of the study. "The planet is under steady siege from interplanetary dust and then regularly passes through this other dust storm, which we think is from comet Encke."

The researchers created detailed computer simulations to test the comet Encke hypothesis. However, the calcium spikes found in the MESSENGER data were offset a bit from the expected results. This shift is probably due to changes in the comet's orbit over time, due to the gravitational pull of Jupiter and other planets. "The variation of Mercury's calcium exosphere with the planet's position in its orbit has been known for several years from MESSENGER observations, but the

proposal that the source of this variation is a meteor shower associated with a specific comet is novel," added MESSENGER Principal Investigator Sean Solomon, of the Lamont-Doherty Earth Observatory at Columbia University in New York. "This study should provide a basis for searches for further evidence of the influence of meteor showers on the interaction of Mercury with its solar-system environment."

<http://phys.org/news/2014-12-ancient-mars-lakes-quakes.html>

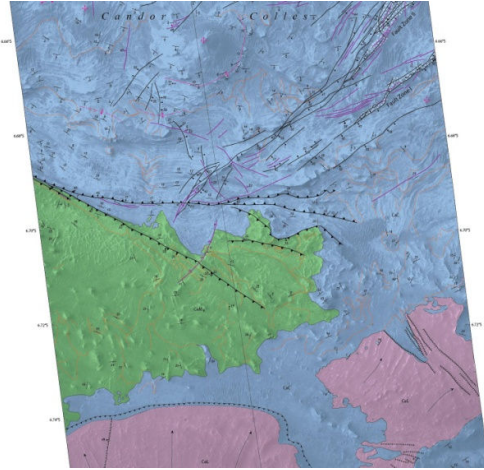
### Signs of ancient Mars lakes and quakes seen in new map

*Long ago, in the largest canyon system in our solar system, vibrations from "marsquakes" shook soft sediments that had accumulated in Martian lakes.*

Dec 15, 2014 by Guy Webster

The shaken sediments formed features that now appear as a series of low hills apparent in a geological map based on NASA images. The map was released today by the U.S. Geological Survey (USGS).

This map of the western Candor Chasma canyon within Mars' Valles Marineris is the highest-resolution Martian geological map ever released by USGS. It is derived from images taken by the High Resolution Imaging Science Experiment (HiRISE) camera on NASA's Mars Reconnaissance Orbiter, which reveal details smaller than a desk.



*Details of hilly terrain within a large Martian canyon are shown on a geological map based on observations from NASA's Mars Reconnaissance Orbiter and produced by the U.S. Geological Survey Astrogeology Science Center, Flagstaff, Arizona. The map shows the structure and geology of a western portion of Mars' Candor Chasma, one of the largest canyons within the longest canyon system in the solar system, Valles Marineris. Landforms in the upper portion of this excerpt from the full map include a series of hills called Candor Colles.*

The map is available for download at: [pubs.usgs.gov/sim/3309/](http://pubs.usgs.gov/sim/3309/). Additional information about the map is available at: [www.usgs.gov/blogs/features/us...\\_st-detailed-one-yet/](http://www.usgs.gov/blogs/features/us..._st-detailed-one-yet/).

"This new map shows that at the time these sediments were deposited, a part of west Candor Chasma, specifically Condor Colles, contained numerous shallow, spring-fed lakes," said map author Chris Okubo of the USGS Astrogeology

Science Center, Flagstaff, Arizona. "These lakes helped to trap wind-blown sand and dust, which accumulated over time and formed the extensive sedimentary deposits we see today." The wet sediments experienced seismic shaking in "marsquakes" related to movement along several large geological faults in the area. A series of low hills resulted.

Valles Marineris is more than 2,500 miles (4,000 kilometers) long. The conditions under which sedimentary deposits in it formed have been an open issue for decades. Possibilities proposed have included accumulation in lakebeds, volcanic eruptions under glaciers within the canyons, and acculation of wind-blown sand and dust.

[http://www.eurekalert.org/pub\\_releases/2014-12/ci-icc121514.php](http://www.eurekalert.org/pub_releases/2014-12/ci-icc121514.php)

### If cells can't move ... cancer can't grow

#### *Centenary's latest research on stopping the spread of tumors*

By blocking a widespread enzyme, Centenary researchers have shown they can slow down the movement of cells and potentially stop tumours from spreading and growing. Using a new super-resolution microscope they've been able to see single molecules of the enzyme at work in a liver cancer cell line. Then they've used confocal microscopes to see how disrupting the enzyme slows down living cancer cells.

The enzyme is DPP9 (dipeptidyl peptidase 9) which the researchers at the Centenary Institute and the Sydney Medical School were first to discover and clone, in 1999. Ever since they've been studying what it does, with a view to its possible use as a cancer drug target. "It was exciting to be able to watch the enzyme at work and then block DPP9, and see the cells slow down," says A/Prof Mark Gorrell from Centenary's Molecular Hepatology unit. "This gives us our clearest evidence yet that this enzyme will be a good cancer drug target."

"What this work has shown us is that this enzyme is absolutely critical to cell movement, and without cell movement, tumors can't grow or spread," says Gorrell of the work, published in the the leading European cell biology journal BBA Molecular Cell Research.

Using the recently acquired super-resolution microscope, Ms Hui (Emma) Zhang--one of Gorrell's PhD students--determined where individual fluorescently tagged DPP9 molecules were located inside cells. She found that DPP9 lies on the microtubules that play a significant role in intracellular transport and in cell migration.

When cells were stimulated to move, Zhang discovered DPP9 accumulates at the leading edge of the moving cell. DPP9 was also associated with the adhesion protein complex that glues the cell to the external matrix through which it moves,



acting as an anchor point to pull the cell along. When the action of DPP9 was inhibited in cells, such movement and adhesion diminished.

"DPP9 is looking more and more like a cancer drug target. But at present we have no specific inhibitors for it, even though chemists have been trying for some years to make one." he said. "We need to throw more resources at this problem."

During the past 15 years, Gorrell has been unveiling the properties of DPP9, which belongs to a small family of four enzymes specialised in cleaving other proteins. Members of this family modify and regulate proteins for many important functions inside and outside of cells. DPP4, for instance, is already the basis of a leading drug treatment for diabetes. DPP4 inhibitors are worth about \$6 billion a year and comprise about a quarter of the diabetes drug market.

"The roadblock to developing a specific inhibitor for DPP9 has been that it is very similar physically, but not functionally, to DPP8. It has been hard to distinguish between the two chemically," Gorrell says. He is now working on determining and publishing differences between the two enzymes, which should help chemists target their efforts better.

"This is our first paper to be generated using this new microscope, which we acquired in collaboration with Sydney University with the help of the Ramaciotti Foundation," the Executive Director of the Centenary Institute, Prof Mathew Vadas AO says. "It is a great illustration of the value of the latest microscope imaging technologies to medical research."

Full release, background, photos and video at:

<http://www.centenary.org.au/p/p/about/media/mediareleases/2014/12/cancer-cant-grow>

[http://www.eurekalert.org/pub\\_releases/2014-12/tinj-fyt121214.php](http://www.eurekalert.org/pub_releases/2014-12/tinj-fyt121214.php)

## Feeling younger than actual age meant lower death rate for older people

### *Turns out, feeling younger than your actual age might be good for you.*

A research letter published online by JAMA Internal Medicine found that older people who felt three or more years younger than their chronological age had a lower death rate compared with those who felt their age or who felt more than one year older than their actual age.

Self-perceived age can reflect assessments of health, physical limitation and well-being in later life, and many older people feel younger than their actual age, according background information in the report. Authors Isla Rippon, M.Sc., and Andrew Steptoe, D.Sc., of the University College London, examined the relationship between self-perceived age and mortality.

The authors used data from a study on aging and included 6,489 individuals, whose average chronological age was 65.8 years but whose average self-perceived age was 56.8 years. Most of the adults (69.6 percent) felt three or more

years younger than their actual age, while 25.6 percent had a self-perceived age close to their real age and 4.8 percent felt more than a year older than their chronological age.

Mortality rates during an average follow-up of 99 months were 14.3 percent in adults who felt younger, 18.5 percent in those who felt about their actual age and 24.6 percent in those adults who felt older, according to the study results. The relationship between self-perceived age and cardiovascular death was strong but there was no association between self-perceived age and cancer death.

"The mechanisms underlying these associations merit further investigation. Possibilities include a broader set of health behaviors than we measured (such as maintaining a healthy weight and adherence to medical advice), and greater resilience, sense of mastery and will to live among those who feel younger than their age. Self-perceived age has the potential to change, so interventions may be possible. Individuals who feel older than their actual age could be targeted with health messages promoting positive health behaviors and attitudes toward aging," the study concludes.

(*JAMA Intern Med.* Published online December 15, 2014.

doi:10.1001/jamainternmed.2014.6580.

[http://www.eurekalert.org/pub\\_releases/2014-12/nyu-lmu121514.php](http://www.eurekalert.org/pub_releases/2014-12/nyu-lmu121514.php)

## Linguistic methods uncover sophisticated meanings, monkey dialects

### *Linguistic analysis reveals local dialects in monkey alarm calls*

The same species of monkeys located in separate geographic regions use their alarm calls differently to warn of approaching predators, a linguistic analysis by a team of scientists reveals. The study, which appears in the journal *Linguistics and Philosophy*, reveals that monkey calls have a more sophisticated structure than was commonly thought.

"Our findings show that Campbell's monkeys have a distinction between roots and suffixes, and that their combination allows the monkeys to describe both the nature of a threat and its degree of danger," explains the study's lead author, Philippe Schlenker, a Senior Researcher at Institut Jean-Nicod within France's National Center for Scientific Research (CNRS) and a Global Distinguished Professor at New York University. The paper may be downloaded here: <http://bit.ly/1zCiHMh>.

The combined team of linguists and primatologists analyzed alarm calls of Campbell's monkeys on two sites: the Tai forest in Ivory Coast and Tiwai Island in Sierra Leone. Notably, monkey predators on the two sites differ: the primates are threatened by eagles on Tiwai Island and by eagles and leopards in the Tai Forest.

Using transcriptions of these monkey calls gathered in field experiments involving playbacks of predator calls (e.g. eagle shrieks and leopard growls), the researchers found greater complexity in expression than previously understood as well as differences in alarm calls between the two locations.

Confirming with linguistic means some hypotheses initially made by primatologists, their analysis showed that these calls make a distinction between roots (especially "hok" and "krak") and suffixes (-oo), and that their combination allows the monkeys to describe both the nature of a threat and its degree of danger. For instance, "hok" warns of serious aerial threats--usually eagles--whereas "hok-oo" can be used for a variety of general aerial disturbances; in effect the suffix -oo serves as a kind of attenuator.

Moreover, their results suggest that the calls are not used in the same way in the Tai Forest and on Tiwai Island. For instance, "krak" usually functions as a leopard alarm call in Tai, but as a general alarm call - to warn of all sorts of disturbances, including eagles - on Tiwai. The article seeks to explain why this 'dialectal variation' is found.

The authors' preferred analysis is based on the device of 'implicatures,' borrowed from the pragmatics of human languages. It posits that the meaning of a word can be enriched when it competes with a more informative alternative - for instance, "possible" competes with "certain," which is more informative, and for this reason "possible" usually comes to mean "possible but not certain" (for instance in: "It's possible that John is the culprit" - which implies that this is not a certainty). The authors propose that "krak" always has a meaning of general alarm, but that in Tai it comes to be enriched by competition with "hok" (meaning: aerial threat) and "krak-oo" (meaning: weak threat) - with the result that it is enriched with a 'not "hok" ' component (hence: the threat is a non-aerial threat) and a 'not "krak-oo" ' component (hence: the threat is not weak). This yields a meaning of a 'serious ground-related threat,' closely associated with leopards.

In the long term, Schlenker observes, the research should help initiate the development of a form of "primate linguistics"--the application of sophisticated methods from contemporary formal linguistics to systems of animal communication.

[http://www.eurekalert.org/pub\\_releases/2014-12/w-eed121514.php](http://www.eurekalert.org/pub_releases/2014-12/w-eed121514.php)

**Even expectant dads experience prenatal hormone changes**  
*Researchers recently completed one of the most extensive investigations to date of prenatal hormones in first-time expectant couples*

Women showed large prenatal increases in salivary testosterone, cortisol, estradiol, and progesterone, while men showed significant prenatal declines in testosterone and estradiol, but no detectable changes in cortisol or progesterone.

While the results in women were expected, the results seen in men suggest that impending fatherhood might cause men's hormone levels to change. Additional studies are warranted to understand whether partners' prenatal hormone changes are linked with postpartum behavior and adjustment.

"Other studies have shown that men's hormones change once they become fathers, but our findings suggest that these changes may begin even earlier, during the transition to fatherhood," said Dr. Robin Edelstein, lead author of the American Journal of Human Biology study. "We don't yet know exactly why men's hormones are changing; these changes could be a function of psychological changes that men experience as they prepare to become fathers, changes in their romantic relationships, or even physical changes that men experience along with their pregnant partners."

[http://www.eurekalert.org/pub\\_releases/2014-12/dbnl-bt121514.php](http://www.eurekalert.org/pub_releases/2014-12/dbnl-bt121514.php)

**Back to future with Roman architectural concrete**  
*Research at Berkeley Lab's Advanced Light Source reveals key to longevity of imperial Roman monuments*

No visit to Rome is complete without a visit to the Pantheon, Trajan's Markets, the Colosseum, or the other spectacular examples of ancient Roman concrete monuments that have stood the test of time and the elements for nearly two thousand years. A key discovery to understanding the longevity and endurance of Roman architectural concrete has been made by an international and interdisciplinary collaboration of researchers using beams of X-rays at the Advanced Light Source (ALS) of the U.S. Department of Energy (DOE)'s Lawrence Berkeley National Laboratory (Berkeley Lab).

Working at ALS beamline 12.3.2, a superconducting bending magnet X-ray micro-diffraction beamline, the research team studied a reproduction of Roman volcanic ash-lime mortar that had been previously subjected to fracture testing experiments at Cornell University. In the concrete walls of Trajan's Markets, constructed around 110 CE, this mortar binds cobble-sized fragments of tuff and brick. Through observing the mineralogical changes that took place in the curing of the mortar over a period of 180 days and comparing the results to 1,900 year old samples of the original, the team discovered that a crystalline binding hydrate prevents microcracks from propagating.

"The mortar resists microcracking through in situ crystallization of platy strätlingite, a durable calcium-alumino-silicate mineral that reinforces interfacial zones and the cementitious matrix," says Marie Jackson, a faculty scientist with the University of California (UC) Berkeley's Department of Civil and Environmental Engineering who led this study. "The dense intergrowths of the platy crystals obstruct crack propagation and preserve cohesion at the micron

scale, which in turn enables the concrete to maintain its chemical resilience and structural integrity in a seismically active environment at the millennial scale." Jackson, a volcanologist by training who led an earlier study at the ALS on Roman seawater concrete, is the lead author of a paper describing this study in the Proceedings of the National Academy of Sciences (PNAS) titled "Mechanical Resilience and Cementitious Processes in Imperial Roman Architectural Mortar." Co-authors of the paper are Eric Landis, Philip Brune, Massimo Vitti, Heng Chen, Qinfei Li, Martin Kunz, Hans-Rudolf Wenk, Paulo Monteiro and Anthony Ingraffea.

The mortars that bind the concrete composites used to construct the structures of Imperial Rome are of keen scientific interest not just because of their unmatched resilience and durability, but also for the environmental advantages they offer. Most modern concretes are bound by limestone-based Portland cement. Manufacturing Portland cement requires heating a mix of limestone and clay to 1,450 degrees Celsius (2,642 degrees Fahrenheit), a process that releases enough carbon - given the 19 billion tons of Portland cement used annually - to account for about seven-percent of the total amount of carbon emitted into the atmosphere each year.

Roman architectural mortar, by contrast, is a mixture of about 85-percent (by volume) volcanic ash, fresh water, and lime, which is calcined at much lower temperature than Portland cement. Coarse chunks of volcanic tuff and brick compose about 45-to-55-percent (by volume) of the concrete. The result is a significant reduction in carbon emissions.

"If we can find ways to incorporate a substantial volumetric component of volcanic rock in the production of specialty concretes, we could greatly reduce the carbon emissions associated with their production also improve their durability and mechanical resistance over time," Jackson says.

As part of their study, Jackson and her collaborators at UC Berkeley used ALS beamline 12.3.2 to make X-ray micro-diffraction measurements of slices of the Roman mortar that were only about 0.3 millimeters thick.

"We obtained X-ray diffractograms for many different points within a given cementitious microstructure," Jackson says. "This enabled us to detect changes in mineral assemblages that gave precise indications of chemical processes active over very small areas."

The mineralogical changes that Jackson and her collaborators observed showed the mortar reproduction gaining strength and toughness over 180 days as calcium-aluminum-silicate-hydrate (C-A-S-H) cementing binder coalesced and strätlingite crystals grew in interfacial zones between volcanic scoria and the mortar matrix. The toughening of these interfacial zones is reflected in the bridging crack

morphology, which was measured by co-author Landis at the University of Maine, using computed tomography scans of the fractured mortar specimens. These experimental results correlate well with computations of increasing fracture energy determined by co-author Brune, now at Dupont Technologies. The strätlingite crystals show no corrosion and their smooth surfaces suggest long-term stability, similar to geological strätlingite that persists for hundreds of thousands of years.

"The in situ crystallization of the strätlingite crystals produces interfacial zones that are very different from any interfacial microstructure observed in Portland cement concretes," Jackson says. "High porosity along the interfacial zones of inert aggregates in Portland cement concrete creates the sites where crack paths first nucleate and propagate."

A future challenge for researchers, Jackson says, will be to "find ways to activate aggregates, as slag or as volcanic ash for example, in innovative concretes so that these can develop strätlingite reinforcements in interfacial zones like the Roman architectural mortars."

The fracture testing experiments at Cornell University were led by co-author Ingraffea. The samples of mortar from Trajan's Markets were provided by co-author Vitti and the Sovrintendenza Capitolina di Roma Capitale. Co-author Kunz is the principal scientist at ALS beamline 12.3.2.

*This research was supported by the National Science Foundation and the Loeb Library at Harvard University. The Advanced Light Source is a DOE Office of Science User Facility.*

<http://www.bbc.com/news/uk-30448325>

### **Colin Norris: Fresh doubt over killer nurse conviction**

***Norris' staff nursing pass Colin Norris was sentenced to 30 years in prison***

**Mark Daly By Mark Daly Panorama**

Four elderly patients of a nurse jailed for at least 30 years for their murders may have died from natural causes, scientific evidence suggests.

"Angel of death" Colin Norris, 37, of Glasgow, was found guilty in 2008 of injecting the four with a fatal dose of insulin, and trying to murder a fifth old woman, at two hospitals in Leeds.

A blood test from one of them had suggested high levels of insulin. But a BBC Panorama investigation has now thrown this result into question.

Bridget Bourke, Irene Crookes, Ethel Hall and Doris Ludlam, died after hypoglycaemic episodes - when the blood sugar drops to dangerously low levels. Vera Wilby recovered from a similar hypoglycaemic episode but died later from an unconnected illness.

June Morrison says she felt as if her "world was closing in" when her son Colin was found guilty of several murders. None was diabetic. And during the five-

month trial at Newcastle Crown Court, the prosecution argued spontaneously occurring hypoglycaemia in non-diabetics was so rare a cluster of five cases must have meant foul play.

But now, Prof Terry Wilkin, an endocrinologist specialising in diabetes, at the University of Exeter, has collaborated on research with a mathematician to try to establish how much insulin would have to have been injected to have given the blood-test result, found in Ethel Hall's case. Prof Wilkin told Panorama: "[The data suggests that] the amount of insulin that would have been required, the amount of insulin injection, was just over a litre [1.8 pints]. "That is unrealistic." At the trial, Dr Adel Ismail, a retired clinical biochemist, suggested a rare condition called insulin autoimmune syndrome (IAS) could have caused the blood-test result. He told Panorama: "They were completely unaware of this, I was talking about things which they had never heard, they never thought, they never investigated, and this was three weeks after the trial had started."

IAS, which can cause inappropriately high insulin levels and hypoglycaemia, was said by prosecution experts at the trial to be too rare to be a possible explanation. But more cases have emerged since 2008.

Prof Wilkin told Panorama: "The data that has come from the analysis that was done on the samples that were given to the laboratory is perfectly consistent with insulin autoimmune syndrome. "So if you're asking me the question, 'Does insulin autoimmune syndrome fit with the facts of the case as reported?' then yes, it does."

In the other four cases, the evidence against Norris was circumstantial, resting on him having been on duty when the elderly women became hypoglycaemic.

### **Verdict 'unsafe'**

But since then, evidence has emerged suggesting hypoglycaemia occurs naturally in up to 10% of sick, elderly people.

Prof Vincent Marks, a world-renowned insulin poisoning expert, told Panorama: "It wasn't as well known at the time of the trial as it is now that in the, particularly the elderly, frail, sick person, hypoglycaemia is far from rare." Prof Vincent Marks Prof Marks says the accepted science on hypoglycaemia has moved on significantly since the trial Prof Marks said the "verdict was unsafe".

He told Panorama: "No reliance should be placed upon the fact that there were four people identified who had low blood glucose levels."

After being shown this new evidence, one of the jurors who had found Norris guilty, who cannot be identified, told Panorama he was now "very doubtful that we come to the right conclusion - very doubtful". He added: "If the new evidence was available at the time... I think they would have thrown the case out."

West Yorkshire Police told Panorama: "Norris was arrested, prosecuted and, on the basis of the evidence presented to the court, he was convicted and sentenced.

"His conviction was upheld at the Court of Appeal in December 2009.

"The case is currently under review by the Criminal Cases Review Commission, and we will consider their findings when they are presented to us."

The BBC is making its evidence available to the commission.

<http://www.bbc.com/news/science-environment-30489814>

### **Microbes discovered by deepest marine drill analysed** *Life uncovered by the deepest-ever marine drilling expedition has been analysed by scientists.*

**By Rebecca Morelle Science Correspondent, BBC News, San Francisco**

The International Ocean Discovery Program (IODP) found microbes living 2,400m beneath the seabed off Japan. The tiny, single-celled organisms survive in this harsh environment on a low-calorie diet of hydrocarbon compounds and have a very slow metabolism.

The findings are being presented at the America Geophysical Union Fall Meeting. Elizabeth Trembath-Reichert, from the California Institute of Technology, who is part of the team that carried out the research, said: "We keep looking for life, and we keep finding it, and it keeps surprising us as to what it appears to be capable of."

The IODP Expedition 337 took place in 2012 off the coast of Japan's Shimokita Peninsula in the northwestern Pacific. From the Chikyu ship, a monster drill was set down more than 1,000m (3,000ft) beneath the waves, where it penetrated a record-breaking 2,446m (8,024ft) of rock under the seafloor.

### **Sluggish ways**

Samples were taken from the ancient coal bed system that lies at this depth, and were returned to the ship for analysis. The team found that microbes, despite having no light, no oxygen, barely any water and very limited nutrients, thrived in the cores. To find out more about how this life from the "deep biosphere" survives, the researchers set up a series of experiments in which they fed the little, spherical organisms different compounds.

Dr Trembath-Reichert said: "We chose these coal beds because we knew there was carbon, and we knew that this carbon was about as tasty to eat, when it comes to coal, as you could get for microbes. "The thought was that while there are some microbes that can eat compounds in coal directly, there may be smaller organic compounds – methane and other types of hydrocarbons - sourced from the coal that the microbes could eat as well."

The experiments revealed that the microbes were indeed dining on these methyl compounds. The tests also showed that the organisms lived life in the slow lane,



with an extremely sluggish metabolism. They seem to use as little energy as possible to get by.

### Other worlds

The researchers are now trying to work out if there are lots of different kinds of microbes living in the coal beds or whether there is one type that dominates.

They also want to find out how the microbes got there in the first place.

"Were these microbes just in a swamp, and loving life in a swamp, because there is all sorts of carbon available, oxygen, organic matter... and then that gets buried?" pondered Dr Trembath-Reichert. "It could be that they didn't get a chance to escape – they couldn't exactly walk out. So is it that they were there to begin with and then they could maintain life? "Or were they like microbes that were able to travel down to those depths from the surface?"

The discovery of vast ecosystems of microbes deeper and deeper underground is causing scientists to reassess the role that these organisms play in the carbon cycle. Because these organisms take in hydrocarbons and expel methane, a greenhouse gas, as a waste product, they may be having a greater impact on the system that governs the Earth's climate than was previously thought.

The findings also have implications for the hunt for life on other planets.

If life can survive in the most extreme conditions on Earth, perhaps it has found a way to cope with harsh environments elsewhere in the cosmos.

[http://www.eurekalert.org/pub\\_releases/2014-12/tuhs-eve121614.php](http://www.eurekalert.org/pub_releases/2014-12/tuhs-eve121614.php)

### Extra vitamin E protected older mice from getting common type of pneumonia

*Extra vitamin E protected older mice from a bacterial infection that commonly causes pneumonia.*

BOSTON - Microbiologists and nutrition researchers from Tufts University report that the extra vitamin E helped regulate the mice's immune system. The findings, published online in advance of print in the *The Journal of Immunology*, show promise for studies investigating the effects of vitamin E and infection in humans. Older adults over age 65 are at high risk for developing pneumonia, an inflammation of the lungs typically caused by infection. The most common type of pneumonia that occurs in this age group is caused by *Streptococcus pneumoniae* bacteria. As a person gets older, the immune system can become weak, making them vulnerable to lung infection. Normally, the body fights this infection using specific white blood cells, known as neutrophils, that enter the lungs and kill the bacteria. If the numbers of neutrophils in the lungs are not well regulated, however, they can cause inflammation and damage. Aging can disrupt the ability of the body to regulate neutrophils.

"Earlier studies have shown that vitamin E can help regulate the aging body's immune system, but our present research is the first study to demonstrate that dietary vitamin E regulates neutrophil entry into the lungs in mice, and so dramatically reduces inflammation, and helps fight off infection by this common type of bacteria," said first author Elsa N. Bou Ghanem, Ph.D., postdoctoral scholar in the department of molecular biology and microbiology at Tufts University School of Medicine (TUSM).

The research team studied older, male mice before and after they were infected with the pneumonia-causing bacteria. Before these mice acquired the infection, they were fed different levels of vitamin E, specifically alpha-tocopherol, over a period of four weeks. One group of mice was fed the recommended amounts of vitamin E (the control group), while another group was fed elevated amounts of vitamin E (the experimental group).

The older mice fed a diet containing extra amounts of vitamin E, the equivalent to about 200 IU/day consumed by humans - about 10 times the Recommended Daily Allowance but well below the upper limit - were far more resistant to the bacteria than the older mice that had a normal amount of vitamin E in their diet.

To measure the differences in immune system function between the two groups of older mice, the researchers examined the lungs to assess damage, counted the number of bacteria in the lungs, and calculated the number of the white blood cells (neutrophils).

Compared to the mice that had normal amounts of vitamin E in their diet, the mice fed extra vitamin E had:

*1,000 times fewer bacteria in their lungs*

*Two times fewer the number of white blood cells (neutrophils)*

The reduced numbers of bacteria and white blood cells resulted in less lung damage in the older mice who received extra vitamin E. These mice were able to control the infection as efficiently as young mice.

"A growing body of research suggests vitamin E could make up for the loss of immune response caused by aging," said co-senior author Simin Nikbin Meydani, D.V.M., Ph.D., director of the Jean Mayer USDA Human Nutrition Research Center on Aging, professor of Nutrition and immunology at the Friedman School of Nutrition Science and Policy, and member of the immunology program faculty at the Sackler School of Graduate Biomedical Sciences. "Whether vitamin E can help protect people against this type of pneumonia affecting older adults requires more research."

"Approximately 900,000 Americans get pneumonia each year; as many as 400,000 patients are hospitalized; and approximately 50,000 die. Vaccines are available but cannot protect everyone, and antibiotic resistance is a problem,



particularly for older adults with pneumonia. Our work provides a better understanding of how nutrition can play a role in modulating how the immune system responds to infection," said co-senior author John M. Leong, M.D., Ph.D., professor and chair of the department of molecular biology and Microbiology at TUSM and member of both the immunology and molecular microbiology program faculties at the Sackler School.

A 2013 report on antibiotic resistance threats from the Centers for Disease Control and Prevention identified infections from *Streptococcus pneumoniae* as a serious concern that requires "prompt and sustained action." The bacterium causes 1.2 million drug-resistant infections, 19,000 excess hospitalizations, 7,000 deaths, and \$96 million in excess medical costs per year. Older adults and young children are at most risk for developing these drug-resistant infections.

*This work was supported in part by Tufts Collaborates Grant M230169 (to A.C., J.M.L., and S.N.M.), U.S. Department of Agriculture Contract 58-1950-0-014 (to S.N.M.), and the A.S.P.E.N. Rhoads Research Foundation 2013 and 2014 Abbott Nutrition grant (to E.N.B.G.). Additional authors are Stacie Clark, now a student in the molecular microbiology program at the Sackler School of Graduate Biomedical Sciences at Tufts; Xiaogang Du, Ph.D., formerly a postdoctoral scholar at the Jean Mayer USDA Human Nutrition Research Center on Aging at Tufts University; Dayong Wu, scientist at the Jean Mayer USDA Human Nutrition Research Center on Aging; and Andrew Camilli, Ph.D., Howard Hughes Medical Institute investigator, professor of molecular biology & microbiology at Tufts University School of Medicine, and member of the molecular microbiology program faculty at the Sackler School. Bou Ghanem, E.N., Clark, S., Du, X., Wu, D., Camilli, A., Leong, J.M., Meydani, S.N. "The alpha-tocopherol form of vitamin E reverses age-associated susceptibility to *Streptococcus pneumoniae* lung infection by modulating pulmonary neutrophil recruitment." *The Journal of Immunology*, 1402401; published ahead of print December 15, 2014, doi:10.4049/jimmunol.140240*

<http://www.jimmunol.org/content/early/2014/12/13/jimmunol.1402401.abstract>

<http://nyti.ms/16DXZBn>

## Fewer Ebola Cases Go Unreported Than Thought, Study Finds

*Far fewer Ebola cases go unreported than has previously been estimated*

By DONALD G. McNEIL Jr. DEC. 16, 2014

Transmission of the Ebola virus occurs mostly within families, in hospitals and at funerals, not randomly like the flu, Yale scientists said Tuesday, and far fewer cases go unreported than has previously been estimated.

That implies, they said, that the epidemic is unlikely to reach the gloomy scenarios of hundreds of thousands of cases that studies released in September had forecast were possible; the most pessimistic one, from the Centers for Disease Control and Prevention, had predicted up to 1.4 million cases by late January.

As of Monday, there were 18,464 confirmed cases in Liberia, Sierra Leone and Guinea, with 6,841 deaths, according to the World Health Organization, far more than from all the previous Ebola outbreaks combined.

The new study, led by epidemiologists from the Yale School of Public Health, was published online by the journal *Clinical Infectious Diseases*. Scientists from Texas, Brazil and the Liberian Health Ministry contributed to the research. The researchers said they had too little data to predict how many West Africans could eventually be infected, but enough to show that the dire predictions were inaccurate.

In a brief written response, the C.D.C. said that its September projection was "a first attempt to better understand to what extent underreporting was occurring in West Africa." The new study, the agency said, "further refines our understanding, and C.D.C. applauds the method."

The worst-case estimates made in September by the C.D.C., the World Health Organization and others were based on what would happen if the world did not mount an effective response. In the months since, donors have committed hundreds of millions of dollars and thousands of soldiers have been sent into the region, while doctors and nurses have volunteered to help.

By looking at virus samples gathered in Sierra Leone and contract-tracing data from Liberia, the scientists working on the new study estimated that about 17 percent of cases in West Africa go unreported, up to a maximum of 70 percent. That is far fewer than earlier estimates.

<http://phys.org/news/2014-12-chance-globally-famous-language.html>

## Your chance of becoming globally famous depends on the language you speak

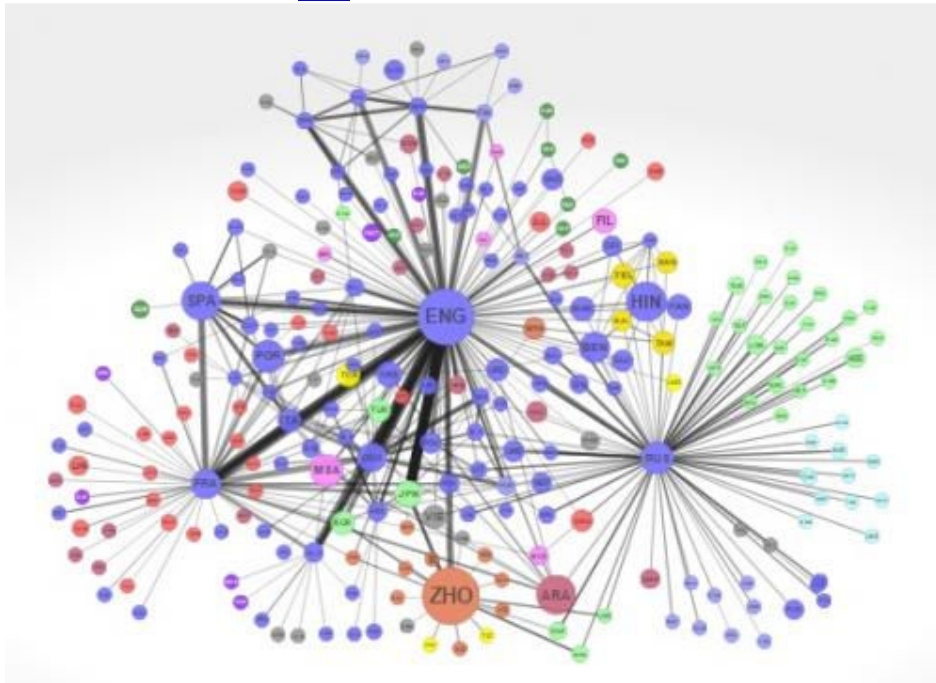
*Is there a connection between language and fame?*

by Lisa Zyga in Other Sciences / Social Sciences

Phys.org - A recent study has found that the number of famous people a country produces is more strongly correlated to that country's language than to its wealth or population. So a person born in an English-speaking country, where the language has a large global influence, has a greater chance of becoming famous than someone born in a country in which the language is less globally influential. This correlation between language and fame is just one result gleaned from the creation of a new global language network. In the new study published in *PNAS*, researchers led by César A. Hidalgo at MIT have mapped out global language networks in order to measure a language's centrality, from which they can extract new insights in a variety of areas.

To do this, the researchers compiled millions of pieces of data in which a piece of written text was translated from one language to another—a feat that has become

possible only in the past few years due to large online data records and the software to analyze it. The researchers used three data sources: 2.2 million book translations from UNESCO's *Index Translationum* project; 382 million Wikipedia edits, where users often made edits to more than one Wikipedia language edition; and 550 million tweets from users who tweeted in more than one language. See the interactive networks [here](#).



*The global language network for book translations. Node sizes are proportional to the number of speakers (native plus nonnative) of each language. Node colors indicate language families, and link colors show the significance of the link. Link widths show the total number of translations. Credit: Ronen, et al.*

*The global language network for book translations. Node sizes are proportional to the number of speakers (native plus nonnative) of each language. Node colors indicate language families, and link colors show the significance of the link. Link widths show the total number of translations. Credit: Ronen, et al.*

To measure the centrality of a language in each of these networks, the researchers used a tool called eigenvector centrality, which is also the basis for Google's PageRank algorithm. This method accounts for not only the connectivity of the language in question, but also that of its neighbors and its neighbors' neighbors, in an iterative manner.

The three global language networks derived from these three data sets are strongly correlated in several ways. All three networks show English as the most central hub, along with a handful of intermediate hub languages, including Spanish, German, and French. Some languages, such as Chinese, Arabic, and Hindi, may be spoken by very large numbers of people, yet are more peripheral in the network due to the low volume of translations between them and the hub languages. This finding supports the well-known problem that the low number of translations into Arabic is a major obstacle in disseminating outside knowledge into the Arab world.

In other ways, the three networks are somewhat different. For instance, the Twitter and Wikipedia datasets exhibit a larger share of languages associated with developing countries, such as Malay, Filipino, and Swahili, compared to the written books dataset. This result suggests that the newer, less formal channels of communication are more inclusive of populations in developing countries, compared to written books.

The eigenvector centrality method also formalizes the intuitive idea that more influential languages provide more direct paths of translations to other languages. For example, the researchers explain that it is easy for an idea conceived by a Spanish speaker to directly reach an English speaker through bilingual speakers of English and Spanish. However, it is more difficult for an idea conceived by a Vietnamese speaker to directly reach a Mapudungun speaker in Chile because far fewer people are bilingual in both Vietnamese and Mapudungun. Instead, the idea might travel from Vietnamese to English to Spanish to Mapudungun.

It also makes sense that better connected languages should increase the visibility of the content produced by the speakers of that language. With this in mind, the researchers wanted to see how closely the eigenvector centrality of a language is correlated to the number of [famous people](#) who were born into that language.

Their list of famous people (born between 1800 and 1950) comes from two sources: [pantheon.media.mit.edu](#) (an MIT project that maps cultural production throughout history) and the book *Human Accomplishment*.

The strong correlation between language and fame may not be that surprising, but it is still impossible to tell from the data alone which is the cause and which the effect: Are the ideas produced in a hub language truly more noteworthy than ideas produced in other languages, causing more of these ideas to be translated into other languages? Or does a person born into a hub language have a greater chance of becoming famous because hub languages promote better visibility of their ideas?

The researchers suggest that the two mechanisms are not mutually exclusive, as they are likely to reinforce each other over time. So a language with high



centrality may signal an abundance of earlier achievements by its speakers, and this rich history has increased the centrality of that language, enhancing the visibility of ideas produced by its current speakers.

In the future, assessments of changes in the structure of the global language networks can reveal important trends, such as whether English is gaining or losing influence with respect to rising powers such as India and China, or whether certain languages are heading toward extinction. In this way, the global language networks complement current predictions of language changes, which rely mostly on the [language's](#) number of speakers.

**More information:** "Links that speak: The global language network and its association with global fame," by Shahar Ronen et al. PNAS, [www.pnas.org/cgi/doi/10.1073/pnas.1410931111](http://www.pnas.org/cgi/doi/10.1073/pnas.1410931111) Watch a video of the researchers explaining similar work [here](#).

<http://1.usa.gov/1xzqF9N>

## NASA Rover Finds Active, Ancient Organic Chemistry on Mars

*NASA's Mars Curiosity rover has measured a tenfold spike in methane*

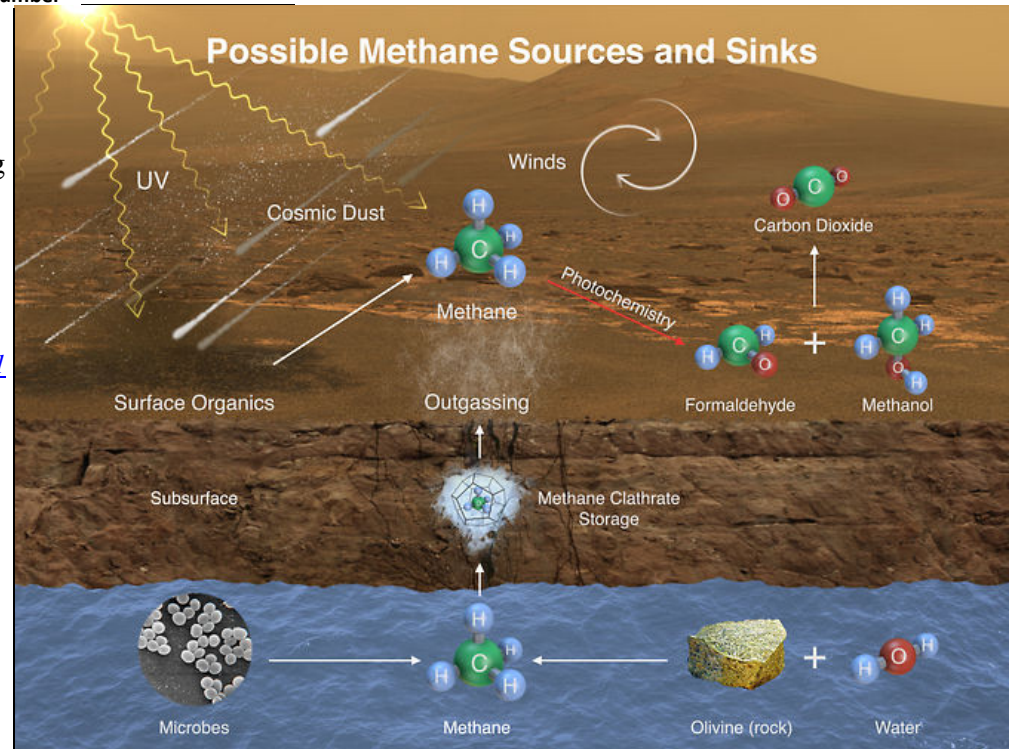
NASA's Mars Curiosity rover has measured a tenfold spike in methane, an organic chemical, in the atmosphere around it and detected other organic molecules in a rock-powder sample collected by the robotic laboratory's drill. Curiosity drilled into this rock target, "Cumberland"

"This temporary increase in methane - sharply up and then back down - tells us there must be some relatively localized source," said Sushil Atreya of the University of Michigan, Ann Arbor, and Curiosity rover science team. "There are many possible sources, biological or non-biological, such as interaction of water and rock."

Researchers used Curiosity's onboard Sample Analysis at Mars (SAM) laboratory a dozen times in a 20-month period to sniff methane in the atmosphere. During two of those months, in late 2013 and early 2014, four measurements averaged seven parts per billion. Before and after that, readings averaged only one-tenth that level.

Curiosity also detected different Martian organic chemicals in powder drilled from a rock dubbed Cumberland, the first definitive detection of organics in surface materials of Mars. These Martian organics could either have formed on Mars or been delivered to Mars by meteorites.

Organic molecules, which contain carbon and usually hydrogen, are chemical building blocks of life, although they can exist without the presence of life. Curiosity's findings from analyzing samples of atmosphere and rock powder do not reveal whether Mars has ever harbored living microbes, but the findings do shed light on a chemically active modern Mars and on favorable conditions for life on ancient Mars.



### Possible Methane Sources and Sinks

*This illustration portrays possible ways that methane might be added to Mars' atmosphere (sources) and removed from the atmosphere (sinks). NASA's Curiosity Mars rover has detected fluctuations in methane concentration in the atmosphere, implying both types of activity occur in the modern environment of Mars. A molecule of methane consists of one atom of carbon and four atoms of hydrogen. Methane can be generated by microbes and can also be generated by processes that do not require life, such as reactions between water and olivine (or pyroxene) rock. Ultraviolet radiation (UV) can induce reactions that generate methane from other organic chemicals produced by either biological or non-biological processes, such as comet dust falling on Mars. Methane generated underground in the distant or recent past might be stored within lattice-structured methane hydrates called clathrates, and released by the clathrates at a later time, so that methane being released to the atmosphere today might have formed in the past. Winds on Mars can quickly distribute methane coming from any individual source, reducing localized concentration of methane. Methane can be removed from the atmosphere by sunlight-induced reactions (photochemistry). These reactions can oxidize the methane, through intermediary*

*chemicals such as formaldehyde and methanol, into carbon dioxide, the predominant ingredient in Mars' atmosphere.*

**Image credit: NASA/JPL-Caltech/SAM-GSFC/Univ. of Michigan**

"We will keep working on the puzzles these findings present," said John Grotzinger, Curiosity project scientist of the California Institute of Technology in Pasadena (Caltech). "Can we learn more about the active chemistry causing such fluctuations in the amount of methane in the atmosphere? Can we choose rock targets where identifiable organics have been preserved?"

Researchers worked many months to determine whether any of the organic material detected in the Cumberland sample was truly Martian. Curiosity's SAM lab detected in several samples some organic carbon compounds that were, in fact, transported from Earth inside the rover. However, extensive testing and analysis yielded confidence in the detection of Martian organics.

Identifying which specific Martian organics are in the rock is complicated by the presence of perchlorate minerals in Martian rocks and soils. When heated inside SAM, the perchlorates alter the structures of the organic compounds, so the identities of the Martian organics in the rock remain uncertain.

"This first confirmation of organic carbon in a rock on Mars holds much promise," said Curiosity participating scientist Roger Summons of the Massachusetts Institute of Technology in Cambridge. "Organics are important because they can tell us about the chemical pathways by which they were formed and preserved. In turn, this is informative about Earth-Mars differences and whether or not particular environments represented by Gale Crater sedimentary rocks were more or less favorable for accumulation of organic materials. The challenge now is to find other rocks on Mount Sharp that might have different and more extensive inventories of organic compounds."

Researchers also reported that Curiosity's taste of Martian water, bound into lakebed minerals in the Cumberland rock more than three billion years ago, indicates the planet lost much of its water before that lakebed formed and continued to lose large amounts after.

SAM analyzed hydrogen isotopes from water molecules that had been locked inside a rock sample for billions of years and were freed when SAM heated it, yielding information about the history of Martian water. The ratio of a heavier hydrogen isotope, deuterium, to the most common hydrogen isotope can provide a signature for comparison across different stages of a planet's history.

"It's really interesting that our measurements from Curiosity of gases extracted from ancient rocks can tell us about loss of water from Mars," said Paul Mahaffy, SAM principal investigator of NASA's Goddard Space Flight Center in Greenbelt,

Maryland, and lead author of a report published online this week by the journal Science

The ratio of deuterium to hydrogen has changed because the lighter hydrogen escapes from the upper atmosphere of Mars much more readily than heavier deuterium. In order to go back in time and see how the deuterium-to-hydrogen ratio in Martian water changed over time, researchers can look at the ratio in water in the current atmosphere and water trapped in rocks at different times in the planet's history.

Martian meteorites found on Earth also provide some information, but this record has gaps. No known Martian meteorites are even close to the same age as the rock studied on Mars, which formed about 3.9 billion to 4.6 billion years ago, according to Curiosity's measurements.

The ratio that Curiosity found in the Cumberland sample is about one-half the ratio in water vapor in today's Martian atmosphere, suggesting much of the planet's water loss occurred since that rock formed. However, the measured ratio is about three times higher than the ratio in the original water supply of Mars, based on assumption that supply had a ratio similar to that measured in Earth's oceans. This suggests much of Mars' original water was lost before the rock formed.

Curiosity is one element of NASA's ongoing Mars research and preparation for a human mission to Mars in the 2030s. Caltech manages the Jet Propulsion Laboratory in Pasadena, California, and JPL manages Curiosity rover science investigations for NASA's Science Mission Directorate in Washington. The SAM investigation is led by Paul Mahaffy of Goddard. Two of SAM instruments key in these discoveries are the Quadrupole Mass Spectrometer, developed at Goddard, and the Tunable Laser Spectrometer, developed at JPL.

The results of the Curiosity rover investigation into methane detection and the Martian organics in an ancient rock were discussed at a news briefing Tuesday at the American Geophysical Union's convention in San Francisco. The methane results are described in a paper published online this week in the journal Science by NASA scientist Chris Webster of JPL, and co-authors.

A report on organics detection in the Cumberland rock by NASA scientist Caroline Freissinet, of Goddard, and co-authors, is pending publication.

For copies of the new Science papers about Mars methane and water, visit:

<http://go.nasa.gov/1cbk35X>

For more information about Curiosity, visit: <http://www.nasa.gov/msl>

and <http://mars.jpl.nasa.gov/msl/> Learn about NASA's Journey to Mars at:

<http://www.nasa.gov/content/nasas-journey-to-mars/>



<http://phys.org/news/2014-12-curiosity-rover-mars.html>

## Curiosity rover makes first detection of organic matter on Mars

### *NASA Goddard instrument makes first detection of organic matter on Mars*

The team responsible for the Sample Analysis at Mars (SAM) instrument suite on NASA's Curiosity rover has made the first definitive detection of organic molecules at Mars. Organic molecules are the building blocks of all known forms of terrestrial life, and consist of a wide variety of molecules made primarily of carbon, hydrogen, and oxygen atoms. However, organic molecules can also be made by chemical reactions that don't involve life, and there is not enough evidence to tell if the matter found by the team came from ancient Martian life or from a non-biological process.

Examples of non-biological sources include chemical reactions in water at ancient Martian hot springs or delivery of organic material to Mars by interplanetary dust or fragments of asteroids and comets.

The surface of Mars is currently inhospitable to life as we know it, but there is evidence that the Red Planet once had a climate that could have supported life billions of years ago. For example, features resembling dry riverbeds and minerals that only form in the presence of liquid water have been discovered on the Martian surface.

The Curiosity rover with its suite of instruments including SAM was sent to Mars in 2011 to discover more about the ancient habitable Martian environment by examining clues in the chemistry of rocks and the atmosphere.

The organic molecules found by the team were in a drilled sample of the Sheepbed mudstone in Gale crater, the landing site for the Curiosity rover. Scientists think the crater was once the site of a lake billions of years ago, and rocks like mudstone formed from sediment in the lake. Moreover, this mudstone was found to contain 20 percent smectite clays. On Earth, such clays are known to provide high surface area and optimal interlayer sites for the concentration and preservation of organic compounds when rapidly deposited under reducing chemical conditions.

While the team can't conclude that there was life at Gale crater, the discovery shows that the ancient environment offered a supply of reduced organic molecules for use as building blocks for life and an energy source for life. Curiosity's earlier analysis of this same mudstone revealed that the environment offered water and chemical elements essential for life and a different chemical energy source.

"We think life began on Earth around 3.8 billion years ago, and our result shows that places on Mars had the same conditions at that time - liquid water, a warm environment, and organic matter," said Caroline Freissinet of NASA's Goddard Space Flight Center in Greenbelt, Maryland. "So if life emerged on Earth in these

conditions, why not on Mars as well?" Freissinet is lead author of a paper on this research submitted to the Journal of Geophysical Research-Planets.

The organic molecules found by the team also have chlorine atoms, and include chlorobenzene and several dichloroalkanes, such as dichloroethane, dichloropropane and dichlorobutane.

Chlorobenzene is the most abundant with concentrations between 150 and 300 parts-per-billion. Chlorobenzene is not a naturally occurring compound on Earth. It is used in the manufacturing process for pesticides (insecticide DDT), herbicides, adhesives, paints and rubber. Dichloropropane is used as an industrial solvent to make paint strippers, varnishes and furniture finish removers, and is classified as a carcinogen.

It's possible that these chlorine-containing organic molecules were present as such in the mudstone. However, according to the team, it's more likely that a different suite of precursor organic molecules was in the mudstone, and that the chlorinated organics formed from reactions inside the SAM instrument as the sample was heated for analysis. Perchlorates (a chlorine atom bound to four oxygen atoms) are abundant on the surface of Mars. It's possible that as the sample was heated, chlorine from perchlorate combined with fragments from precursor organic molecules in the mudstone to produce the chlorinated organic molecules detected by SAM.

In 1976, the Gas Chromatograph Mass Spectrometer instrument on NASA's Viking landers detected two simple chlorinated hydrocarbons after heating Martian soils for analysis (chloromethane and dichloromethane). However they were not able to rule out that the compounds were derived from the instrument itself, according to the team. While sources within the SAM instrument also produce chlorinated hydrocarbons, they don't make more than 22 parts-per-billion of chlorobenzene, far below the amounts detected in the mudstone sample, giving the team confidence that organic molecules really are present on Mars.

The SAM instrument suite was built at NASA Goddard with significant elements provided by industry, university, and national and international NASA partners. For this analysis, the Curiosity rover sample acquisition system drilled into a mudstone and filtered fine particles of it through a sieve, then delivered a portion of the sample to the SAM laboratory. SAM detected the compounds using its Evolved Gas Analysis (EGA) mode by heating the sample up to about 875 degrees Celsius (around 1,600 degrees Fahrenheit) and then monitoring the volatiles released from the sample using a quadrupole mass spectrometer, which identifies molecules by their mass using electric fields.

SAM also detected and identified the compounds using its Gas Chromatograph Mass Spectrometer (GCMS) mode. In this mode, volatiles are separated by the

amount of time they take to travel through a narrow tube (gas chromatography - certain molecules interact with the sides of the tube more readily and thus travel more slowly) and then identified by their signature mass fragments in the mass spectrometer.

The first evidence for elevated levels of chlorobenzene and dichloroalkanes released from the mudstone was obtained on Curiosity Sol 290 (May 30, 2013) with the third analysis of the Cumberland sample at Sheepbed. The team spent over a year carefully analyzing the result, including conducting laboratory experiments with instruments and methods similar to SAM, to be sure that SAM could not be producing the amount of organic material detected.

"The search for organics on Mars has been extremely challenging for the team," said Daniel Glavin of NASA Goddard, a co-author on the paper.

"First, we need to identify environments in Gale crater that would have enabled the concentration of organics in sediments. Then they need to survive the conversion of sediment to rock, where pore fluids and dissolved substances may oxidize and destroy organics. Organics can then be destroyed during exposure of rocks at the surface of Mars to intense ionizing radiation and oxidants. Finally, to identify any organic compounds that have survived, we have to deal with oxychlorine compounds and possibly other strong oxidants in the sample which will react with and combust organic compounds to carbon dioxide and chlorinated hydrocarbons when the samples are heated by SAM."

As part of Curiosity's plan for exploration, an important strategic goal was to sample rocks that represent different combinations of the variables thought to control organic preservation. "The SAM and Mars Science Laboratory teams have worked very hard to achieve this result," said John Grotzinger of Caltech, Mars Science Laboratory's Project Scientist.

"Only by drilling additional rock samples in different locations, and representing different geologic histories were we able to tease out this result. At the time we first saw evidence of these organic molecules in the Cumberland sample it was uncertain if they were derived from Mars, however, additional drilling has not produced the same compounds as might be predicted for contamination, indicating that the carbon in the detected organic molecules is very likely of Martian origin."

NASA's Mars Science Laboratory Project is using Curiosity to assess ancient habitable environments and major changes in Martian environmental conditions. NASA's Jet Propulsion Laboratory in Pasadena, California, a division of Caltech, built the rover and manages the project for NASA's Science Mission Directorate in Washington.

[http://www.eurekalert.org/pub\\_releases/2014-12/puww-mth121614.php](http://www.eurekalert.org/pub_releases/2014-12/puww-mth121614.php)

## **More than half of all children in the US will likely live with an unmarried mother**

*More than half of all American children will likely live with an unmarried mother at some point before they reach age 18*

PRINCETON, N.J.--More than half of all American children will likely live with an unmarried mother at some point before they reach age 18, according to a report issued by Princeton University and Harvard University.

The absence of a biological father increases the likelihood that a child will exhibit antisocial behaviors like aggression, rule-breaking and delinquency, the researchers report in the journal *EducationNext*.

This finding - which holds true regardless of a child's race - is especially prevalent among young boys. As a result, these children are 40 percent less likely to finish high school or attend college.

Researchers Sara McLanahan of Princeton's Woodrow Wilson School of Public and International Affairs and Christopher Jencks of Harvard wrote their report to coincide with the 50th anniversary of the controversial "Moynihan Report," a 1965 study by sociologist Daniel Patrick Moynihan (who later served as a New York senator) that argued that growing up in homes without a male breadwinner led to a life of poverty, unemployment and crime, especially for African Americans.

McLanahan and Jencks are among some of the first researchers to examine the trends Moynihan projected since his report was furiously denounced in the '60s. The researchers found that since 1965, the percentage of children raised by unmarried mothers has risen from 25 to 50 percent among blacks, and 7 to 19 percent among whites. ("Unmarried" mothers are defined only by marital status, not whether the mother lives with a partner.)

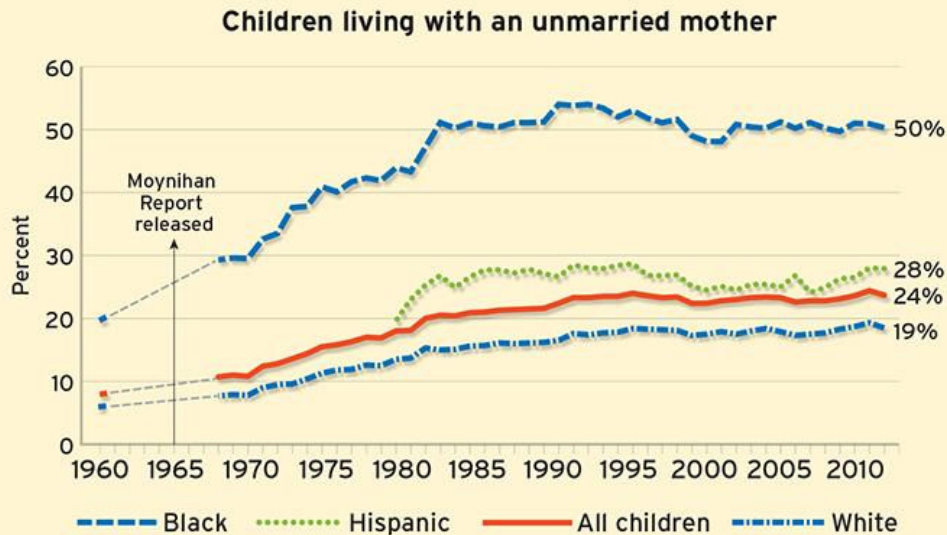
However, the racial makeup of single-mother families has not changed much over time. In 1970, 31 percent of single-mother families were black, 68 percent were white and 1 percent were "other race."

In 2013, the figures were 30 percent black, 62 percent white and 8 percent "other." Evidence on the impact of these trends comes from the Fragile Families and Child Wellbeing study, pioneered by McLanahan, which is following a cohort of nearly 5,000 children born in large American cities between 1998 and 2000. In the past five decades, the meaning of single motherhood has changed dramatically, McLanahan and Jencks write. Single mothers today are far less likely than their predecessors to have ever been married.

Now, single motherhood usually occurs earlier in a child's life, or even at the very beginning. It is not uncommon for women to be single when their first child is

### The Changing American Family (Figure 1)

*The percentage of children under 18 living with an unmarried mother has increased substantially since the 1960s, with the largest increase seen among blacks.*



NOTES: Prior to 1968, Black denotes all nonwhites, including Asians and Native Americans; beginning in 1968, these data include blacks only. Respondents who indicated more than one race are not included in these data. Respondents of Hispanic origin are included in both racial categories and are identified separately beginning in 1980. Families headed by an unmarried mother include those in which the mother is never married, divorced, separated (married but spouse absent), or widowed.

SOURCE: U.S. Census Bureau, Decennial Census, 1960; Current Population Survey, Annual Social and Economic Supplements, 1968 to 2013

born. Also, the high rate of partner turnover during a mother's peak fertility years means that children now experience multiple men entering and exiting their lives.

*The percentage of children under age 18 living with an unmarried mother has increased substantially since the 1960s, with the largest increase seen among blacks*

EducationNext

"Both the departure of a father and the arrival of a mother's new partner disrupt family routines and are stressful for most children, regardless of whether the father was married to the mother or just living with her," said McLanahan, director of the Bendheim-Thoman Center for Research on Child Wellbeing at Princeton's Woodrow Wilson School of Public and International Affairs.

"Likewise, this shift to never-married motherhood has probably weakened the economic and emotional ties between children and their absent fathers."

Another change is that unmarried motherhood has spread fastest among mothers who have not completed college. For blacks, the number of children living with a mother who lacks a high school diploma has increased from 56 percent in 1980 to 66 percent in 2010. For whites, the percentage of children whose mothers lack a high school degree has remained essentially unchanged, hovering at around 18 percent between 1980 and 2010.

The official poverty rate in 2013 among all families with children was 40 percent if the family was headed by an unmarried mother and only 8 percent if the family was headed by a married couple. Among blacks, the rates were 46 percent in single-mother families and 12 percent in married-parent families. Among Hispanics, the figures were 47 percent and 18 percent, and among whites the rates were 32 percent and 4 percent, respectively.

"The fact that single motherhood is increasing faster among women with less than a college degree means that children growing up with a single mother are likely to be doubly disadvantaged," said McLanahan.

"They spend less time and receive less money from their biological fathers than children who live with their fathers. At the same time, the mother - who is now the primary breadwinner - has lower earnings than the typical mother in a married-parent family."

Changing the current dynamic will be difficult, the authors write. It would require giving less-educated women incentives to invest in education and careers and to use more reliable contraceptive methods, McLanahan and Jencks said. At the same time, the economic prospects of the young men who father the children also must improve.

"None of this will be easy," McLanahan said. "But it would improve the lives of the men in question, perhaps reduce their level of antisocial behavior and improve the lives of their children, through all the benefits that flow from a stable home." The article, "Was Moynihan right? What happens to the children of unmarried mothers," was published Dec. 9 by EducationNext, a journal of opinion and research.



[http://www.eurekalert.org/pub\\_releases/2014-12/vu-mmh121614.php](http://www.eurekalert.org/pub_releases/2014-12/vu-mmh121614.php)

### **Microbiome may have shaped early human populations**

*We humans have an exceptional age structure compared to other animals: Our children remain dependent on their parents for an unusually long period and our elderly live an extremely long time after they have stopped procreating.*

Could the microscopic fellow travelers that consider the human body to be their home - collectively known as the microbiome - have played an active role in shaping and maintaining this unusual aspect of human nature?

That is the speculative proposition advanced by Martin Blaser, professor of medicine and microbiology at NYU's Langone Medical Center, and supported by mathematical models produced by Glenn Webb, professor of mathematics at Vanderbilt University. They present their argument in a paper titled, "Host demise as a beneficial function of indigenous microbiota in human hosts," published online today in mBio, the journal of the American Society for Microbiology. Scientists have known for a long time that every species of plant and animal acts as host for a distinctive collection of microorganisms. The human microbiome consists of about 100 trillion microbial cells, outnumbering the much larger human cells by about 10 to 1. Until recently they thought that the influence these microscopic communities have on their hosts was extremely limited. But recent research has found that their influence extends well beyond aiding digestion and producing bodily odors; they also aid brain development, reproduction and defense against infection. Taken together, the new evidence has led to the hologenomic theory of evolution, which proposes that the object of Darwin's natural selection is not just the individual organism as he proposed, but the organism plus its associated microbial community.

Blaser got the idea for the impact of microbes on human age structure from his lifetime research on *Helicobacter pylori*, a bacterium found in the stomach of more than 50 percent of the world's population.

*H. pylori* co-exists peacefully in people's stomachs for most of their lives. It even has some beneficial effects. In 1996, for example, Blaser discovered that it may help regulate levels of stomach acid. However, *H. pylori* is also a major cause of stomach cancer, a risk that increases with age.

"I began thinking that a real symbiont is an organism that keeps you alive when you are young and kills you when you are old. That's not particularly good for you, but it's good for the species," Blaser said.

Webb's expertise is the development of nonlinear differential equations to describe dynamic biological processes. So the microbiologist turned to him to see if they could come up with a mathematical model that would test this idea.

The approach they agreed upon was to create a model of an early hunter-gather population and see what role the microbiome might have played.

"We don't have many facts to go on, so we don't know what happened a thousand generations ago," Webb said. "But differential equations are all about change and by comparing different rates of change to one another we can tell what works and what doesn't work."

One of their basic assumptions was that people haven't changed much in the last 100,000 generations. In particular, they had the capability to live up to 120 years, which seems to be the current limit on human longevity. Of course, they had shorter average lifetimes because they had a number of sources of mortality that have been largely eliminated in modern society: fewer outbreaks of infectious diseases due to improved sanitation, reduction in back-breaking physical labor, increased availability of food, and modern medicines like antibiotics.

Their model divided the population into three different age groups: juvenile, reproductive and senescent. They looked at how the population would respond to different combinations of fertility and mortality rates. They developed a baseline case using the best estimates of these rates that they could find.

Then they added mortality risks based on particular microbial profiles.

In one version, they added a risk factor based on *Shigella*, one of the leading bacterial causes of diarrhea worldwide. This increased mortality only among children. It caused the population to crash.

In another version, they added an *H. pylori*-type mortality factor, one that increases with age. They found that this decreased the percentage of the senescent population, which benefitted the juvenile population by reducing the elderly's demand on food and resources. The end result was stronger population growth and greater stability than the baseline case.

These results are consistent with Blaser's contention that evolution may have acted on the human microbiome to favor bacteria like *H. pylori* that target the aging. "This isn't good for the individual, but it is good for the species," Blaser said. Anything the bacteria can do to stabilize the human population benefits them because they lose their hosts if the population crashes.

They researchers also decided to see what happened when they doubled the fertility rate. The result was an unstable system that was thrown into catastrophic boom-bust cycles in response to disasters (events that caused major population loss).

In another variation, they increased the proportion of elderly in the hunter-gatherer population. They found it didn't take much of an increase to force the population into a state of decline.



In addition to providing validation to the proposition that the microbiome may be shaping the human age structure, Webb observed that the modeling effort also reveals an underlying truth about human population growth. We have the right fertility and mortality rates to support our unusual age structure.

"If you go back 30,000 to 40,000 years ago, there were only 30,000 to 40,000 people in the world and they were scattered over Africa, Europe and parts of Asia," said Webb. "Are we lucky just to be here? Or did we survive because our ancestors were robust enough to handle all the environmental changes and natural disasters they encountered? According to our equations, it was because they were robust enough."

*The research was supported in part by grants R01 GM63270 and R01 DK090989 from the National Institutes of Health and by grants from the Ellison Medical Foundation and the Diane Belfer Program in Human Microbial Ecology.*

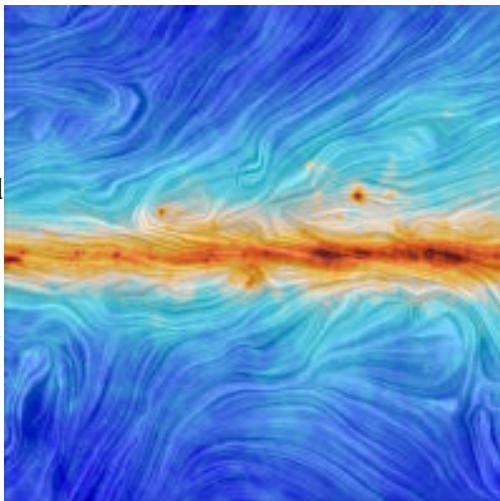
<http://scitechdaily.com/interaction-interstellar-dust-galaxys-magnetic-field/>

## The Interaction Between Interstellar Dust and Our Galaxy's Magnetic Field

*While the pastel tones and fine texture of this image may bring to mind brush strokes on an artist's canvas, they are in fact a visualization of data from ESA's Planck satellite.*

The image portrays the interaction between interstellar dust in the Milky Way and the structure of our Galaxy's magnetic field.

Between 2009 and 2013, Planck scanned the sky to detect the most ancient light in the history of the Universe – the cosmic microwave background. It also detected significant foreground emission from diffuse material in our Galaxy which, although a nuisance for cosmological studies, is extremely important for studying the birth of stars and other phenomena in the Milky Way.



*Using data from the Planck collaboration, this newly released image portrays the interaction between interstellar dust in the Milky Way and the structure of our Galaxy's magnetic field. ESA/Planck Collaboration. Acknowledgment: M.-A. Miville-Deschênes, CNRS – Institut d'Astrophysique Spatiale, Université Paris-XI, Orsay, France*

Among the foreground sources at the wavelengths probed by Planck is cosmic dust, a minor but crucial component of the interstellar medium that pervades the Galaxy. Mainly gas, it is the raw material for stars to form.

Interstellar clouds of gas and dust are also threaded by the Galaxy's magnetic field, and dust grains tend to align their longest axis at right angles to the direction of the field. As a result, the light emitted by dust grains is partly 'polarized' – it vibrates in a preferred direction – and, as such, could be caught by the polarization-sensitive detectors on Planck.

Scientists in the Planck collaboration are using the polarized emission of interstellar dust to reconstruct the Galaxy's magnetic field and study its role in the build-up of structure in the Milky Way, leading to star formation.

In this image, the color scale represents the total intensity of dust emission, revealing the structure of interstellar clouds in the Milky Way. The texture is based on measurements of the direction of the polarized light emitted by the dust, which in turn indicates the orientation of the magnetic field.

This image shows the intricate link between the magnetic field and the structure of the interstellar medium along the plane of the Milky Way. In particular, the arrangement of the magnetic field is more ordered along the Galactic plane, where it follows the spiral structure of the Milky Way. Small clouds are seen just above and below the plane, where the magnetic field structure becomes less regular. From these and other similar observations, Planck scientists found that filamentary interstellar clouds are preferentially aligned with the direction of the ambient magnetic field, highlighting the strong role played by magnetism in galaxy evolution.

The emission from dust is computed from a combination of Planck observations at 353, 545 and 857 GHz, whereas the direction of the magnetic field is based on Planck polarisation data at 353 GHz.

<http://bit.ly/1xAcPUA>

## Antibiotic Resistance Will Kill 300 Million People by 2050

*New report says pharma companies make more money from other drugs, so shy away from new antibiotic development*

By [Anthony King](#) and [ChemistryWorld](#)

The true cost of antimicrobial resistance (AMR) will be 300 million premature deaths and up to \$100 trillion (£64 trillion) lost to the global economy by 2050. This scenario is set out in a [new report which looks to a future where drug resistance is not tackled](#) between now and 2050.

The report predicts that the world's GDP would be 0.5% smaller by 2020 and 1.4% smaller by 2030 with over 100 million premature deaths. The Review on

Antimicrobial Resistance, chaired by Jim O'Neill, is significant in that it is a global review that seeks to quantify financial costs.

This issue goes beyond health policy and, on a strictly macroeconomic basis, it makes sense for governments to act now, the report argues. "One of the things that has been lacking is putting some pound signs in front of this problem," says [Michael Head](#) at the Farr institute, University College London, UK, who sees hope in how a response to HIV came about. "The world was slow to respond [to HIV], but when the costs were calculated the world leapt into action."

He recently totted up R&D for infectious diseases in the UK and found [gross underinvestment in antibacterial research](#): £102 million compared to a total of £2.6 billion. Other research shows that less than 1% of available research funds in the UK and Europe [were spent on antibiotic research in 2008–2013](#).

### **Bleak future**

RAND Europe and KPMG both assessed the future impact of AMR. They looked at a subset of drug resistant pathogens and the public health issues surrounding them for *Klebsiella pneumoniae*, *Escherichia coli*, *Staphylococcus aureus*, HIV, tuberculosis and malaria. The RAND Europe scenario modelled what would happen if antimicrobial drug resistance rates rose to 100% after 15 years, while infection rates held steady. The KPMG scenario looked at resistance rising to 40% from today's levels and the number of infections doubling. Malaria resistance results in the greatest number of fatalities, while *E. coli* resistance accounts for almost half the total economic impact as it is so widespread and its incidence is so high.

"You can look at antibiotic resistance as a slow moving global train wreck, which will happen over the next 35 years," says health law expert [Kevin Outterson](#) at Boston University, US. "If we do nothing, this report shows us the likely magnitude of the costs."

Outterson headed up a recent [Chatham House report](#) on new business models for antibiotics that highlighted the problem of inadequate market incentives. "If I came out with a new cardiovascular drug, it could be worth tens of billions of dollars a year," he says. "But if we had the same innovative product as an antibiotic, we would save it for the sickest and it would sell modestly in the first decade. So market uptake is extraordinarily limited for innovative antibiotics and all for excellent public health reasons."

### **Incentivising action**

The solution is to de-link return on investment and volume sales. "Instead of companies getting their return on R&D investment by selling volumes of product, they would be paid something by governments or health players for access to that

antibiotic," he explains. Outterson is now working on a report that will outline how this could work.

Another approach is to re-use old drugs. "Developing new antibiotics will take many years and we cannot wait," says [Ursula Theuretzbacher](#) at the Center for Anti-Infective Agents in Vienna, Austria. "In the meantime we decided we need to improve the usage of some selected old drugs that had not been in use for many years." An EU-funded project, [AIDA](#), is running clinical trials on five drugs developed before the 1980s.

Theuretzbacher has been pleased by public money going into helping small companies move their innovative antibiotics towards market. In the US, companies such as Achaogen, Cempra and Trias, acquired by [Cubist, itself just bought up by Merck](#), have made use of these schemes. Meanwhile, in Europe, there are several EU funded projects, Wellcome Trust schemes and public-private partnerships such as the [Innovative Medicines Initiative](#) and its [New Drugs for Bad Bugs](#) programme.

[Richard Smith](#), health systems economist at the London School of Hygiene & Tropical Medicine, UK, was a member of the RAND team and adviser to KPMG. He says the report's headline figures are not an exaggeration and are more likely an underestimate. "It takes into account effects on labour productivity and labour workforce issues, but we don't know what the public reaction will be: from previous pandemics and outbreaks we know behavioural effects can be much worse on an economy than the impact of the disease," he says. The report concluded that they "most likely underestimate the true costs of AMR" due to a lack of reliable data.

"When we understand a threat, governments respond with energy and with money," Outterson says. The US recently agreed to put over \$5 billion into fighting Ebola. "The threat posed by bacterial resistance is even greater than that of Ebola," he adds. "If this report accurately predicts the world we live in in 2050, then we will have failed on a monumental scale to preserve a global public good."

[http://www.eurekalert.org/pub\\_releases/2014-12/osu-sht121614.php](http://www.eurekalert.org/pub_releases/2014-12/osu-sht121614.php)

### **Study hints that ancient Earth made its own water - geologically Evidence that rock circulating in the mantle feeds world's oceans even today Ohio State University**

SAN FRANCISCO--A new study is helping to answer a longstanding question that has recently moved to the forefront of earth science: Did our planet make its own water through geologic processes, or did water come to us via icy comets from the far reaches of the solar system?

The answer is likely "both," according to researchers at The Ohio State University - and the same amount of water that currently fills the Pacific Ocean could be buried deep inside the planet right now.

At the American Geophysical Union (AGU) meeting on Wednesday, Dec. 17, they report the discovery of a previously unknown geochemical pathway by which the Earth can sequester water in its interior for billions of years and still release small amounts to the surface via plate tectonics, feeding our oceans from within.

In trying to understand the formation of the early Earth, some researchers have suggested that the planet was dry and inhospitable to life until icy comets pelted the earth and deposited water on the surface.

Wendy Panero, associate professor of earth sciences at Ohio State, and doctoral student Jeff Pigott are pursuing a different hypothesis: that Earth was formed with entire oceans of water in its interior, and has been continuously supplying water to the surface via plate tectonics ever since.

Researchers have long accepted that the mantle contains some water, but how much water is a mystery. And, if some geological mechanism has been supplying water to the surface all this time, wouldn't the mantle have run out of water by now?

Because there's no way to directly study deep mantle rocks, Panero and Pigott are probing the question with high-pressure physics experiments and computer calculations.

"When we look into the origins of water on Earth, what we're really asking is, why are we so different than all the other planets?" Panero said. "In this solar system, Earth is unique because we have liquid water on the surface. We're also the only planet with active plate tectonics. Maybe this water in the mantle is key to plate tectonics, and that's part of what makes Earth habitable."

Central to the study is the idea that rocks that appear dry to the human eye can actually contain water--in the form of hydrogen atoms trapped inside natural voids and crystal defects. Oxygen is plentiful in minerals, so when a mineral contains some hydrogen, certain chemical reactions can free the hydrogen to bond with the oxygen and make water.

Stray atoms of hydrogen could make up only a tiny fraction of mantle rock, the researchers explained. Given that the mantle is more than 80 percent of the planet's total volume, however, those stray atoms add up to a lot of potential water. In a lab at Ohio State, the researchers compress different minerals that are common to the mantle and subject them to high pressures and temperatures using a diamond anvil cell--a device that squeezes a tiny sample of material between two diamonds and heats it with a laser--to simulate conditions in the deep Earth.

They examine how the minerals' crystal structures change as they are compressed, and use that information to gauge the minerals' relative capacities for storing hydrogen. Then, they extend their experimental results using computer calculations to uncover the geochemical processes that would enable these minerals to rise through the mantle to the surface--a necessary condition for water to escape into the oceans.

In a paper now submitted to a peer-reviewed academic journal, they reported their recent tests of the mineral bridgmanite, a high-pressure form of olivine. While bridgmanite is the most abundant mineral in the lower mantle, they found that it contains too little hydrogen to play an important role in Earth's water supply. Another research group recently found that ringwoodite, another form of olivine, does contain enough hydrogen to make it a good candidate for deep-earth water storage. So Panero and Pigott focused their study on the depth where ringwoodite is found--a place 325-500 miles below the surface that researchers call the "transition zone"--as the most likely region that can hold a planet's worth of water. From there, the same convection of mantle rock that produces plate tectonics could carry the water to the surface.

One problem: If all the water in ringwoodite is continually drained to the surface via plate tectonics, how could the planet hold any in reserve?

For the research presented at AGU, Panero and Pigott performed new computer calculations of the geochemistry in the lowest portion of the mantle, some 500 miles deep and more. There, another mineral, garnet, emerged as a likely water-carrier--a go-between that could deliver some of the water from ringwoodite down into the otherwise dry lower mantle.

If this scenario is accurate, the Earth may today hold half as much water in its depths as is currently flowing in oceans on the surface, Panero said--an amount that would approximately equal the volume of the Pacific Ocean. This water is continuously cycled through the transition zone as a result of plate tectonics.

"One way to look at this research is that we're putting constraints on the amount of water that could be down there," Pigott added.

Panero called the complex relationship between plate tectonics and surface water "one of the great mysteries in the geosciences." But this new study supports researchers' growing suspicion that mantle convection somehow regulates the amount of water in the oceans. It also vastly expands the timeline for Earth's water cycle. "If all of the Earth's water is on the surface, that gives us one interpretation of the water cycle, where we can think of water cycling from oceans into the atmosphere and into the groundwater over millions of years," she said. "But if mantle circulation is also part of the water cycle, the total cycle time for our planet's water has to be billions of years."

[http://www.eurekalert.org/pub\\_releases/2014-12/osu-twc121714.php](http://www.eurekalert.org/pub_releases/2014-12/osu-twc121714.php)

## Top weather conditions that amplify Lake Erie algal blooms revealed

### *Seasons with low winds lead to spread of harmful algae*

SAN FRANCISCO--Of the many weather-related factors that contribute to harmful algal blooms (HABs) in Lake Erie, a new study has identified one as most important: the wind. Over a 10-year period in Lake Erie, wind speed contributed more consistently to HABs than sunshine or even precipitation, researchers at The Ohio State University and their colleagues found.

The ongoing study is unusual, in that researchers are building the first detailed analyses of how the various environmental factors influence each other--in the context of satellite studies of Lake Erie. They gave their early results at the American Geophysical Union meeting on Dec. 17.

To C.K. Shum, Distinguished University Scholar and professor of geodetic science at Ohio State, the finding "underscores the need for environmental agencies to incorporate the threat of extreme weather events caused by climate change into future algae mitigation strategies."

Where other studies have linked weather phenomena to HABs, this study goes a step further to look at how environmental drivers impact each other, and "ranks" them by their relative importance in promoting HABs, said Song Liang, formerly of Ohio State and now an associate professor of environmental and global health at the University of Florida.

"What surprised us the most was how the impact of nonweather factors, such as nitrogen and phosphorus pollution, varied strongly by season, while weather factors remained consistently important throughout the year," he said.

Researchers have long known that high nitrogen and phosphorus levels are the actual causes of HABs, which choke freshwater ecosystems and render the water toxic. But when it comes to the various environmental factors that can amplify the amount of these nutrients in the water, or aid or hamper the spread of algae, the relationships are much more complex.

"One of the objectives of this project is investigating historical patterns of harmful algal blooms and their linkage to water quality and environmental factors," explained project leader Jiyoung Lee, associate professor of environmental health sciences at Ohio State. "By doing this, we can better understand and predict the future of HABs and water safety in the Lake Erie community with the impact of changing climate and environmental factors."

Liang and his group analyzed nine environmental factors, including solar radiation, wind speed, precipitation, nitrogen concentration, water temperature

and water quality in Lake Erie from 2002 to 2012. Then the larger research team used data from the sensor onboard the European Space Agency's Envisat satellite MEdium Resolution Imaging Spectrometer (MERIS) to examine how the color of the lake water changed during those years--an indication of the concentration of the toxic blue-green algae present in HABs.

The researchers examined the environmental drivers by season, and found that wind speed affected the spread of algal blooms consistently throughout spring, summer and fall. Seasons of low winds led to larger blooms. That's because when wind speed is low, lake water is more still, and algae can more easily float to the top and form thick mats that spread along the lake surface.

Sunlight, meanwhile, was important in the spring and summer as a source of energy for the algae. Precipitation was very important in the summer and the winter, when rains and melting snow boosted runoff and delivered nitrogen and phosphorus, which algae use as food sources, to the lake.

As the project continues, the researchers hope to get a better understanding of how the variables relate to each other, and explore the notion of weather and climate as factors in a kind of "early warning system" for HABs.

*The U.S. Environmental Protection Agency funded this research.*

<http://bit.ly/1raj5jM>

## What Forms of Creativity Turn You On?

*It's no secret: [creativity is sexy](#).*

By [Scott Barry Kaufman](#)

People all over the world rank creativity as a [highly desirable quality in a partner](#), and people who are creative across a variety of fields [report more sexual partners](#) (similar results have been found in specific fields such as [visual art](#), [music](#), and [humor](#)). But are all forms of creativity equally attractive?

According to evolutionary psychologist Geoffrey Miller, [creative displays in humans are analogous to the peacock's tail](#): they serve the function of attracting mates by serving as indicators of mental fitness (cognitive functioning and personality).

Extending this argument, personality psychologist [Gregory Feist](#) made a key distinction between *applied/technological* displays of creativity (seen in modern domains of technology, science, and engineering), and *ornamental/aesthetic* displays of creativity (seen in modern domains of art, music, and other aesthetic domains). According to Feist, ornamental/aesthetic forms of creativity-- which play on our evolved perceptual functions and evoke strong emotions in the perceiver-- were shaped primarily by sexual selection pressures and are therefore more likely to receive a sexual response than applied/technological forms of creativity.



Such displays are also more likely to be passed on to future generations and become part of the cultural record. As Daniel Nettle points out in his terrific book

[Strong Imagination: Madness, Creativity and Human Nature](#):

“You remember Beethoven and Brahms, but can you name a single innovator in the field of sewer construction and sewage treatment?”

You probably can't, even though the latter has probably saved more lives than the former. After all, why is it that American Idol finalists get a townwide parade in their home towns, whereas PhD candidates in psychology, for instance, get a parade attended only by their parents and grandparents?

But hold up, you say. To each his or her own. What is one man's trash is another man's treasure, right?

Well, maybe. These are the sort of questions that motivated a study I conducted with Gregory Feist and my colleagues Aaron Kozbelt, Paul Silvia, James Kaufman, and Sheela Ramesh, and which we report in a new paper called [Who Finds Bill Gates Sexy? Creative Mate Preferences as Function of Cognitive Ability, Personality, and Creative Achievement](#).

First we created the “Creative Behavior Mating Preferences Checklist”, in which people are asked to rank 43 creative behaviors according to how much they find each behavior “sexually attractive in a potential mate.” Then we investigated the best cognitive, personality, and creative achievement predictors of the various items on the scale.

For all the nuance, I highly recommend [downloading the paper](#). But here are a few highlights:

*For both males and females on average, ornamental/aesthetic forms of creativity were considered more sexually attractive than applied/technological forms of creativity. These findings are consistent with Feist's theory about human creative mate preferences at a species-typical level.*

**On average, here are the top 10 sexiest creative behaviors:**

1. *Playing sports*
2. *Taking a date on a spontaneous road trip*
3. *Recording music*
4. *Making a clever remark*
5. *Writing music*
6. *Performing in a band*
7. *The taking of artistic photographs*
8. *Performing in comedy*
9. *Dressing in a unique style*
10. *Writing poetry*

**On average, here are the top 10 least sexy creative behaviors:**

1. *Making ad campaigns*

2. *Interior decorating*

3. *Writing an original computer program*

4. *Making websites*

5. *Growing and gardening*

6. *Presenting scientific or mathematical papers*

7. *Exterior decorating*

8. *Applying math in an original way to solve a practical problem*

9. *The development of scientific experimental designs*

10. *Participating in drama production*

*BUT... We also found substantial differences in reported mate preferences among people, and these differences could be predicted based on personality. People who scored higher in intellectual curiosity, enjoyment of cognitively complex reasoning, and who reported more creative achievements in the sciences tended to find applied/technological forms of creativity incredibly sexy in a potential partner. In contrast, the best predictor of a preference for ornamental/aesthetic forms of creativity among both males and females was [openness to experience](#): a preference for engagement with sensory, aesthetic, fantasy, and emotional information. Interestingly, among males, higher levels of intellectual curiosity actually were associated with less of a preference for ornamental/aesthetic displays of creativity in a potential mate. Not sure what to make of that finding though.*

Taken together, these results suggest that even though creative displays that evoke perceptual, aesthetic, and emotional qualities in the perceiver are considered most sexually attractive by most humans, assortative mating (“like attracts likes”) very much operates within the creativity domain. So for all those out there who get turned on by creative behaviors such as “Writing an original computer program”, or “Presenting scientific or mathematical papers at a conference”, know that you aren't alone, and there's some programmer out there who will find your own creative behaviors intoxicatingly attractive!

[http://www.eurekalert.org/pub\\_releases/2014-12/nlmc-rg121514.php](http://www.eurekalert.org/pub_releases/2014-12/nlmc-rg121514.php)

**'Master regulator' gene - long tied to autism disorders - stimulates other genes in early brain development**

*Finding caps 3 years of research led by biochemists at NYU Langone Medical Center*

Chemical modifications to DNA's packaging - known as epigenetic changes - can activate or repress genes involved in autism spectrum disorders (ASDs) and early brain development, according to a new study to be published in the journal Nature on Dec. 18.

Biochemists from NYU Langone Medical Center found that these epigenetic changes in mice and laboratory experiments remove the blocking mechanism of a protein complex long known for gene suppression, and transitions the complex to a gene activating role instead.

Researchers say their findings represent the first link between this role reversal and the presence of an important protein whose encoding gene - autism susceptibility candidate gene 2 or AUTS2 - has long been tied to ASDs. They also say their study offers a novel theory about how ASDs develop through widespread unraveling of traditional brain pathways.

Specifically, researchers showed that AUTS2 converts polycomb repressive complex 1 (PRC1) - one of a group of proteins involved in transcriptional regulation during development - to a gene-activating role, during which it prevents a chemical modification change to histone H2A, a main DNA-packaging protein in all cells with a nucleus.

According to senior study investigator Danny Reinberg, PhD, a professor at NYU School of Medicine and a Howard Hughes Medical Institute investigator, his team's latest findings "offer strong supporting evidence that if ASDs can be tied to widespread disruption of gene networks from multiple genetic lesions, then finding potential therapies could rest on research into repairing these gene network interruptions."

Among the study's other key findings, researchers found that disrupting the function of AUTS2 in mice led to behaviors that were comparable to the neurologically delayed autistic behaviors observed in people. Researchers have already estimated that nearly half of all people with AUTS2 mutations have been diagnosed with some form of the syndrome. Additional experiments found that AUTS2 proteins were dominant in the cortex region of the mouse brain - the part of the brain involving memory, attention, and learning - and were more present in the first few weeks of life than after mice reach adulthood.

To further affirm their findings on the role of AUTS2 in controlling the syndrome, researchers genetically interrupted AUTS2 expression in mice and measured behavioral and motor-reflex effects. Mice with disrupted AUTS2 were slow to react, taking twice as long to right themselves after being placed on their backs, and making fewer than half as many calls after their mothers were taken away, than mice whose AUTS2 production was not impaired. Most AUTS2-deficient mice were also significantly shorter and had lower birth weights than mice producing AUTS2.

Reinberg, whose earlier research in 2012 helped differentiate among various polycomb repressive complexes, also says the new findings point to AUTS2 as a "master regulator" controlling a key transcriptional program during early brain

development. Researchers began the latest study after unexpectedly recording some AUTS2 protein interaction with PRC1 while trying to better define all the PRC1 complexes.

Reinberg's team plans further study of AUTS2 and its activities in other parts of the brain to uncover other possible links to ASDs or other neurological conditions, such as attention deficit hyperactivity disorder (ADHD) and schizophrenia.

*Funding support for the study was provided by National Institutes of Health grants R01 GM64844, IDP2 MH100012-01, 5T32 CA160002-03, IF32 GM105275-01A1, and F32 AA022842. Additional funding support came from the Howard Hughes Medical Institute, the Simons Foundation Autism Research Initiative, and the Brain and Behavioral Research Fund Young Investigator Award.*

*Besides Reinberg, other NYU Langone researchers involved in these experiments were lead study investigators Zhonghua Gao, PhD; Pedro Lee, PhD; and James Stafford, PhD.*

*Additional research support was provided by Anne Schaefer, MD, PhD, and Melanie von Schimmelmann, PhD, at Mount Sinai School of Medicine, also in New York.*

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### Scientists open new frontier of vast chemical 'space'

*As proof-of-principle, the TSRI team makes dozens of new chemical entities*

LA JOLLA, CA - Chemists at The Scripps Research Institute (TSRI) have invented a powerful method for joining complex organic molecules that is extraordinarily robust and can be used to make pharmaceuticals, fabrics, dyes, plastics and other materials previously inaccessible to chemists.

"We are rewriting the rules for how one thinks about the reactivity of basic organic building blocks, and in doing so we're allowing chemists to venture where none has gone before," said Phil S. Baran, the Darlene Shiley Chair in Chemistry at TSRI, whose laboratory reports the finding on functionalized olefin cross-coupling this week in Nature.

With the new technique, scientists can join two compounds known as olefins to create a new bond between their carbon-atom backbones. Carbon-to-carbon coupling methods are central to chemistry, but until now have been plagued by certain limitations: they often fail if either of the starting compounds contains small, reactive regions known as "functional groups" attached to their main structure. They also frequently don't work well in the presence of "heteroatoms"--non-carbon atoms such as nitrogen, oxygen and iodine--despite the importance of these types of atoms in chemical synthesis.

The new method is what chemists call "mild," meaning that it doesn't require the use of extreme temperatures or pressures, nor harsh chemicals. As a result, portions of the building blocks used that are particularly fragile remain unaltered by the reaction. "Functional groups that would be destroyed by other cross-coupling methods are totally unscathed when using our method," said Julian C. Lo,

a graduate student who was a co-lead author of the report with Research Associate Jinghan Gui.

### Natural Products as Launching Pad

The innovation arose from a Baran laboratory project to synthesize natural compounds found in traditional Chinese medicines. As they developed a technique for constructing the desired molecules in the lab, the researchers recognized that they could adapt the technique to join two relatively simple olefins together, as they reported in January 2014 in the *Journal of the American Chemical Society*.

The next step was to adapt the technique in order to combine more complex olefins attached to heteroatoms, which is reported in the new Nature paper.

"The reaction setup is easy," said Gui. "We use a simple iron catalyst, a commercially available silane and ethanol [i.e., grain alcohol] as the solvent; and we can do the reaction in an open flask, meaning that we don't need to exclude air or moisture."

Lo, Gui and their colleagues demonstrated the robustness of their reaction by taking an unconventional approach and running it in vodka, gin, whiskey, tequila, beer and wine instead of pure alcohol. "Think of wine--it has this incredibly complex flavor because of the hundreds of compounds in it besides alcohol. And yet our reaction is still able to proceed in that mess, whereas traditional coupling techniques can't even handle water that well," said Lo.

### Immediate Applications, New Vistas

Importantly, the chemists showed that their reaction can be used to make compounds that were previously either unpractical to synthesize or couldn't have been made at all. In their report they described making more than 60 compounds with the new method. "Around 90% of these are new chemical entities," said Baran. "We expect that this method will have immediate application to pharmaceuticals, materials, and even agricultural and fragrance chemistry." Indeed Baran already has used the method to help one company solve a difficult chemical synthesis problem and has disseminated the method's details to other researchers at scientific meetings. Beyond the immediate practical applications, the new method removes some significant constraints on chemists' thinking, essentially opening up new worlds of possibilities. "This new chemistry allows for bond constructions that have previous been simply unimaginable," said Baran. *Other authors of the paper, "Functionalized Olefin Cross-Coupling to Construct Carbon-Carbon Bonds," were Yuki Yabe and Chung-Mao Pan of TSRI. For more information, see <http://www.nature.com>*

*Funding for the research was provided in part by the U.S. National Institute of General Medical Sciences, part of the National Institutes of Health (GM-097444).*

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### Study identifies 53 approved drugs that may block Ebola infection

*Compounds may keep virus from entering cells; may accelerate drug development*

Researchers found 53 existing drugs that may keep the Ebola virus from entering human cells, a key step in the process of infection, according to a study led by researchers at the Icahn School of Medicine at Mount Sinai and the National Institutes of Health (NIH), and [published today in the Nature Press journal \*Emerging Microbes and Infections\*](#).

Among the better known drug types shown to hinder infection by an Ebola virus model: several cancer drugs, antihistamines and antibiotics. Among the most effective at keeping the virus out of human cells were microtubule inhibitors used to treat cancer.

"In light of the historic and devastating outbreak of Ebola virus disease, there is an urgent need to rapidly develop useful treatments against Ebola infection, and our study results argue that repurposing existing drugs may be among the fastest ways to achieve this," said lead author Adolfo García-Sastre, PhD, Director of the Global Health and Emerging Pathogens Institute within the Icahn School of Medicine at Mount Sinai. "Many of the compounds identified in [this study](#) promise to become lead compounds in near-future drug development efforts studies targeting this virus," said Dr. García-Sastre, also the Fishberg Chair and Professor of Medicine (Infectious Diseases) within the School.

There is no approved treatment for Ebola virus infection, and the estimated mortality rate of the current Ebola outbreak is nearly 70 percent in many areas. Antibody-based therapy (e.g. ZMapp) has proven effective in animal studies, and has been used for the treatment of a few patients, but has not been confirmed in clinical trials. It is also expensive to make and in short supply. Ebola vaccine trials are getting underway as well, but vaccines will not be available for some time. "NCATS is all about getting more treatments to more patients more quickly, and this is never more urgent than in the case of a public health emergency like Ebola," said Christopher P. Austin, MD, Director of the National Center for Advancing Translational Sciences (NCATS), part of the NIH, which also led the study. "This remarkable team of scientists combined NCATS' expertise in drug screening and development with Mt. Sinai's expertise in Ebola virology to rapidly identified candidate treatments for Ebola infection."

Specifically, the research team used a miniaturized, high-speed technology to screen through sample libraries of 2,816 compounds already approved by the US Food and Drug Administration for other uses. Their assay was designed to



identify compounds that blocked the ability of the Ebola virus to enter and infect human cells by at least 50 percent.

While fully intact Ebola virus is a biosafety level (BSL) 4 pathogen and dangerous to work with, the team created a virus-like particle comprised of the Ebola proteins (glycoproteins and matrix proteins) that enable the virus to enter cells, but without many of the genes and proteins that make the virus deadly. When they inserted a fluorescent reporter protein in this virus-like shell, their test became capable of high-speed screening to see which drugs blocked the entry of Ebola-like viral particles into cells as measured by fluorescence. These Ebola mimics can be studied in a BSL-2 facility, making them much safer to work with. The team's screen yielded 53 drugs that block Ebola virus-like particles from entering human cells. Along with the drug types mentioned above, other categories that blocked viral entry included estrogen receptor modulators used against cancer and serotonin reuptake inhibitors used to treat depression. Some of the compounds had been shown by previous studies to counter Ebola lifecycle steps. Next steps include testing of the re-purposed drug candidates in animal studies to see if useful doses against the virus come with toxic side effects. If any of prove to be safe and effective, the "government may opt to deploy them in the outbreak areas," said Dr. García-Sastre.

*Carles Martínez-Romero, PhD, an instructor in the Department of Microbiology within the Icahn School of Medicine, also led the research at Mount Sinai. NCATS study authors were Wei Zheng, Jennifer Kouznetsova, Wei Sun, Gregory Tawa, Paul Shinn, Catherine Chen, Philip Sanderson, and John McKew. Aaron Schimmer of Princess Margaret Cancer Centre, part of the University Health Network in Toronto, was also a study author.*

*This work was supported by grants from NCATS and the NIH. The development of antiviral screen assays in Dr. García-Sastre's lab was also supported by NIH grants (R01AI079110 and R01AI089539).*

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### **Study: 49 percent of patients withhold clinically sensitive information**

#### ***Almost half of patients withheld clinically sensitive information from their health care providers***

In the first real-world trial of the impact of patient-controlled access to electronic medical records, almost half of the patients who participated withheld clinically sensitive information in their medical records from some or all of their health care providers.

This is the key finding of a new study by researchers from Clemson University, the Regenstrief Institute, Indiana University School of Medicine and Eskenazi Health published in the Journal of General Internal Medicine.

Kelly Caine, assistant professor in Clemson's School of Computing, and colleagues at Clemson led the human factors efforts on the project. She and her team interviewed patients about their privacy and sharing preferences and used this information to design the user interface that allowed patients to control how and to whom their medical data was shared.

During the six-month trial, 105 patients were able to indicate preferences for which clinicians could access sensitive information in their electronic medical records, such as information on sexually transmitted diseases, substance abuse or mental health, and designating what the clinicians could see.

Patients were able to hide some or all of their data from some or all providers. However, the health care providers were able to override patients' preferences and view any hidden data, if they felt the patient's health care required it, by clicking a "break the glass" button on their computer screens. When providers clicked this button, the program recorded the time, the patient whose electronic chart was being viewed and the data displayed.

In the trial, 49 percent of the patients who participated elected to withhold information contained in their medical records from some or all of their health care providers. Patients strongly desired such control, while their providers had mixed reactions. More than half believed it was OK for patients to withhold some health information. On the other hand, a quarter of providers felt very uncomfortable about not being able to see all of the information in their patients' records, worrying that it could jeopardize care.

"It is critically important to consider patients' privacy preferences about their health information," Caine said. "If we fail to design systems that meet patients' needs and desires about the extent to which their health data are shared, patients will reject them or even refuse to seek care."

The results from this trial demonstrated that patients not only say they would like control over their medical records, but actually put that control into practice when it's available. "It is important for patients to have confidence in how clinicians and others use their sensitive health information," said Lucia Savage, chief privacy officer of the Office of the National Coordinator for Health Information Technology.

"Patient-centered decision making in electronic health information exchange can inspire trust in health IT and the papers in the journal, along with this study, give us new insights on these issues." "Our patient-centered work can inform the design of a system that preserves patient privacy and autonomy, meets providers' needs and improves care," Caine said.

The results of the trial are presented, interpreted and analyzed in five peer-reviewed research papers describing how the patient-controlled system was



developed, how the trial was conducted and how patients and their providers felt about patient control; a point-counterpoint discussion written by Caine; and commentaries that comprise the supplement to the Journal of General Internal Medicine.

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**Lens-free microscope can detect cancer at the cellular level**  
*UCLA researchers develop device that can do the work of pathology lab microscopes*

UCLA researchers have developed a lens-free microscope that can be used to detect the presence of cancer or other cell-level abnormalities with the same accuracy as larger and more expensive optical microscopes.

The invention could lead to less expensive and more portable technology for performing common examinations of tissue, blood and other biomedical specimens. It may prove especially useful in remote areas and in cases where large numbers of samples need to be examined quickly.

The microscope is the latest in a series of computational imaging and diagnostic devices developed in the lab of Aydogan Ozcan, the Chancellor's Professor of Electrical Engineering and Bioengineering at the UCLA Henry Samueli School of Engineering and Applied Science and a Howard Hughes Medical Institute professor. Ozcan's lab has previously developed custom-designed smartphone attachments and apps that enable quick analysis of food samples for allergens, water samples for heavy metals and bacteria, cell counts in blood samples, and the use of Google Glass to process the results of medical diagnostic tests.

The latest invention is the first lens-free microscope that can be used for high-throughput 3-D tissue imaging - an important need in the study of disease.

"This is a milestone in the work we've been doing," said Ozcan, who also is the associate director of UCLA's California NanoSystems Institute. "This is the first time tissue samples have been imaged in 3D using a lens-free on-chip microscope."

The research is the cover article today in Science Translational Medicine, which is published by the American Association for the Advancement of Science.

The device works by using a laser or light-emitting-diode to illuminate a tissue or blood sample that has been placed on a slide and inserted into the device. A sensor array on a microchip - the same type of chip that is used in digital cameras, including cellphone cameras - captures and records the pattern of shadows created by the sample.

The device processes these patterns as a series of holograms, forming 3-D images of the specimen and giving medical personnel a virtual depth-of-field view. An algorithm color codes the reconstructed images, making the contrasts in the

samples more apparent than they would be in the holograms and making any abnormalities easier to detect.

Ozcan's team tested the device using Pap smears that indicated cervical cancer, tissue specimens containing cancerous breast cells, and blood samples containing sickle cell anemia. In a blind test, a board-certified pathologist analyzed sets of specimen images that had been created by the lens-free technology and by conventional microscopes. The pathologist's diagnoses using the lens-free microscopic images proved accurate 99 percent of the time.

Another benefit of the lens-free device is that it produces images that are several hundred times larger in area, or field of view, than those captured by conventional bright-field optical microscopes, which makes it possible to process specimens more quickly.

"While mobile health care has expanded rapidly with the growth of consumer electronics - cellphones in particular - pathology is still, by and large, constrained to advanced clinical laboratory settings," Ozcan said. "Accompanied by advances in its graphical user interface, this platform could scale up for use in clinical, biomedical, scientific, educational and citizen-science applications, among others."

*In addition to Ozcan, the principal authors of the research were Alon Greenbaum, a UCLA Engineering graduate student and a research fellow at HHMI, and Yibo Zhang, a UCLA Engineering graduate student. Other authors were UCLA Engineering graduate student Wei Luo, undergraduate researchers Alborz Feizi and Ping-Luen Chung, and Dr. Shivani Kandukuri of the department of pathology and laboratory medicine at the David Geffen School of Medicine at UCLA.*

*The research was supported by the Presidential Early Career Award for Scientists and Engineers, the National Science Foundation, the National Institutes of Health, the Army Research Office, the Office of Naval Research and the Howard Hughes Medical Institute.*

<http://nyti.ms/13qxPzA>

**For First Time, Treatment Helps Patients With Worst Kind of Stroke, Study Says**

*After three decades of failure, researchers have found a treatment that greatly improves the prognosis for people having the most severe and disabling strokes.*

By GINA KOLATA DEC. 17, 2014

By directly removing large blood clots blocking blood vessels in the brain, they can save brain tissue that would have otherwise died, enabling many to return to an independent life.

The study, published online Wednesday in The New England Journal of Medicine and conducted by researchers in the Netherlands, is being met with an outpouring of excitement. One reason the treatment worked, researchers suspect, is that doctors used a new type of snare to grab the clots. It is a stent, basically a small

wire cage, on the end of a catheter that is inserted in the groin and threaded through an artery to the brain. When the tip of the catheter reaches the clot, the stent is opened and pushed into the clot. It snags the clot, allowing the doctor to withdraw the catheter and pull out the stent with the clot attached.

“This is a game changer,” said Dr. Ralph L. Sacco, chairman of neurology at the University of Miami’s Miller School of Medicine.

“A sea change,” said Dr. Joseph Broderick, director of the neuroscience institute at the University of Cincinnati.

About 630,000 Americans each year have strokes caused by clots blocking blood vessels in the brain. In about a third to half, the clot is in a large vessel, which has potentially devastating consequences. People with smaller clots are helped by the lifesaving drug tPA, which dissolves them. But for those with big clots, tPA often does not help. Until now, no other treatments had been shown to work.

The new study involved 500 stroke patients. Ninety percent got tPA. Half were randomly assigned to get a second treatment as well. A doctor would try to directly remove the clot from the patient’s brain. The study did not specify how the removal would happen. There are several methods, but the vast majority were treated with the new stent.

One in five patients who had tPA alone recovered enough to return to living independently. But one in three who also had their clot removed directly were able to take care of themselves after their stroke. And that, said Dr. Larry B. Goldstein, director of the Duke Stroke Center, is “a significant and meaningful improvement in what people are able to do.”

It has been a long road to this success, explained Dr. Walter J. Koroshetz, acting director of the National Institute of Neurological Disorders and Stroke. It began in the 1980s when researchers began testing intravenous tPA. In 1995, when the first large study was published demonstrating tPA’s effectiveness, stroke experts were jubilant. They were left, though, with the problem of helping people with large clots.

Companies began marketing various clot-snaring devices, but there were no studies showing they helped. Using them could be risky — some involved pushing wires through twisting blood vessels that often were damaged already from atherosclerosis, Dr. Koroshetz explained. “You could puncture an artery and if you do and get bleeding in the brain, you have a problem,” he said. Another problem was that sometimes fragments of a clot could break off and be swept deeper into the brain, causing new strokes.

The systems were also expensive. Giving a patient tPA cost about \$11,100. Using one of the new devices could cost \$23,000, Dr. Koroshetz said.

But some neurologists were enthusiastic. The Food and Drug Administration cleared the first device for clot removal in 2004, allowing it to be marketed. The clearance was granted because the agency considered the device to be equivalent to something already in use — devices used to snare pieces of wires or catheters that might break off in a blood vessel during a medical procedure.

That, other neurologists said, was not at all the same as going into the brain to grab a clot. “There was a lot of controversy,” Dr. Koroshetz said. But the devices quickly came into widespread use. It took time and experience for doctors to learn to use the devices, and not everyone had the necessary expertise.

Even so, said Dr. Diederik Dippel, professor of neurology at Erasmus University Medical Center and principal investigator for the new study, when his study was about to begin, people questioned why it was even needed. “People said why bother with a clinical trial. Just do it,” Dr. Dippel said.

The Dutch study began in 2010. In the meantime, several other large clinical trials testing clot removal were well underway, including one sponsored by the National Institute of Neurological Disorders and Stroke and headed by Dr. Broderick. By 2012, with 650 out of the planned 1,000 patients enrolled, the American study was ended. “Because of futility,” Dr. Koroshetz said. It had become clear that, if anything, those randomized to have their clots directly removed were doing no better.

Two other clinical trials also ended without showing benefit. All too often, attempts to remove clots resulted in uncontrolled bleeding in the brain.

Gloom settled over the field. In the Netherlands, Dr. Dippel said, attitudes about the trial reversed. “Everyone said, ‘Why should we go on?’” Dr. Dippel said.

But the Dutch study happened to start at a time when there were a few key developments that made it possible to hope for success. There was new technology that allowed doctors to quickly assess whether a stroke patient had a large clot and, if so, where it was. In previous studies they tried to guess from a patient’s symptoms. And the stent system for snagging a clot seemed safer and easier to use than previous devices. The stent system, said Dr. Dippel, “was clearly a better device than we were used to.”

Of course, said Dr. Goldstein, he would like to see the results confirmed with other studies. But, he and others say, that may already have happened. Two other studies like the Dutch one were just ended early because the results were so positive. The data will be presented in February at the International Stroke Conference in Nashville.

Now neurologists are increasingly confident that, at last, they have something in addition to tPA to offer patients.

“I think this is the real thing,” Dr. Koroshetz said.

<http://bit.ly/Lxay9AD>

## Strange Rock from Russia Contains 30,000 Diamonds

*Here's the perfect Christmas gift for the person who has everything: A red and green rock, ornament-sized, stuffed with 30,000 teeny-tiny diamonds.*

Dec 17, 2014 11:20 AM ET // by Becky Oskin, LiveScience

The sparkly chunk was pulled from Russia's huge Udachnaya diamond mine and donated to science (the diamonds' tiny size means they're worthless as gems). It was a lucky break for researchers, because the diamond-rich rock is a rare find in many ways, scientists reported Monday (Dec. 15) at the American Geophysical Union's annual meeting.

"The exciting thing for me is there are 30,000 itty-bitty, perfect octahedrons, and not one big diamond," said Larry Taylor, a geologist at the University of Tennessee, Knoxville, who presented the findings. "It's like they formed instantaneously."

***This rock from Russia's Udachnaya mine contains 30,000 diamonds.*** Larry Taylor The concentration of diamonds in the rock is millions of times greater than that in typical diamond ore, which averages 1 to 6 carats per ton, Taylor said. A carat is a unit of weight (not size), and is roughly equal to one-fifth of a gram, or 0.007 ounces. [Sinister Sparkle Gallery: 13 Mysterious & Cursed Gemstones] The astonishing amount of diamonds, and the rock's unusual Christmas coloring, will provide important clues to Earth's geologic history as well as the origin of these prized gemstones, Taylor said. "The associations of minerals will tell us something about the genesis of this rock, which is a strange one indeed," he said. Although diamonds have been desired for centuries, and are now understood well enough to be recreated in a lab, their natural origins are still a mystery.

"The reactions in which diamonds occur still remain an enigma," Taylor told Live Science.

Scientists think diamonds are born deep below Earth's surface, in the layer between the crust and core called the mantle. Explosive volcanic eruptions then carry hunks of diamond-rich mantle to the surface. However, most mantle rocks disintegrate during the trip, leaving only loose crystals at the surface. The Udachnaya rock is one of the rare nuggets that survived the rocketing ride. Taylor works with researchers at the Russian Academy of Sciences to study Udachnaya diamonds. The scientists first probed the entire rock with an industrial X-ray tomography scanner, which is similar to a medical CT scanner but capable



of higher X-ray intensities. Different minerals glow in different colors in the X-ray images, with diamonds appearing black.

The thousands upon thousands of diamonds in the rock cluster together in a tight band. The clear crystals are just 0.04 inches (1 millimeter) tall and are octahedral, meaning they are shaped like two pyramids that are glued together at the base. The rest of the rock is speckled with larger crystals of red garnet, and green olivine and pyroxene. Minerals called sulfides round out the mix. A 3D model built from the X-rays revealed the diamonds formed after the garnet, olivine and pyroxene minerals.

Exotic materials captured inside diamonds, in tiny capsules called inclusions, can also provide hints as to how they were made. The researchers beamed electrons into the inclusions to identify the chemicals trapped inside. The chemicals included carbonate, a common mineral in limestone and seashells, as well as garnet.

Altogether, the findings suggest the diamonds crystallized from fluids that escaped from subducted oceanic crust, likely composed of a dense rock called peridotite, Taylor reported Monday. Subduction is when one of Earth's tectonic plates crumples under another plate. The results will be published in a special issue of Russian Geology and Geophysics next month (January 2015), Taylor said. The unusual chemistry would represent a rare case among diamonds, said Sami Mikhail, a researcher at the Carnegie Institution for Science in Washington, D.C., who was not involved in the study. However, Mikhail offered another explanation for the unusual chemistry. "[The source] could be just a really, really old formation that's been down in the mantle for a long time," he said.

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## **Fine particulate air pollution linked with increased autism risk** ***Women exposed to high levels of fine particulate matter, particularly during the third trimester may face up to twice the risk of having a child with autism***

Boston, MA -- Women exposed to high levels of fine particulate matter specifically during pregnancy--particularly during the third trimester--may face up to twice the risk of having a child with autism than mothers living in areas with low particulate matter, according to a new study from Harvard School of Public Health (HSPH). The greater the exposure, the greater the risk, researchers found. It was the first U.S.-wide study exploring the link between airborne particulate matter and autism. "Our data add additional important support to the hypothesis that maternal exposure to air pollution contributes to the risk of autism spectrum disorders," said Marc Weisskopf, associate professor of environmental and occupational epidemiology and senior author of the study. "The specificity of our findings for

the pregnancy period, and third trimester in particular, rules out many other possible explanations for these findings."

The study appears online December 18, 2014 in Environmental Health Perspectives and will be available at <http://ehp.niehs.nih.gov/1408133>.

Prior studies have suggested that, in addition to genetics, exposure to airborne environmental contaminants, particularly during pregnancy and early life, may affect risk of autism. This study focused specifically on the pregnancy period. The study population included offspring of participants living in all 50 states in Nurses' Health Study II, a cohort of more than 116,000 female U.S. nurses begun in 1989.

The researchers collected data on where participants lived during their pregnancies as well as data from the U.S. Environmental Protection Agency and other sources on levels of fine particulate matter air pollution (PM2.5)--particles 2.5 microns in diameter or smaller--in locations across the U.S. The researchers identified 245 children who were diagnosed with autism spectrum disorder (ASD) and a control group of 1,522 children without ASD during the time period studied. The researchers explored the association between autism and exposure to PM2.5 before, during, and after pregnancy. They also calculated exposure to PM2.5 during each pregnancy trimester.

Exposure to PM2.5 was significantly associated with autism during pregnancy, but not before or after, the study found. And during the pregnancy, the third trimester specifically was significantly associated with an increased risk. Little association was found between air pollution from larger-sized particles (PM10-2.5) and autism.

"The evidence base for a role for maternal exposure to air pollution increasing the risk of autism spectrum disorders is becoming quite strong," said Weisskopf.

"This not only gives us important insight as we continue to pursue the origins of autism spectrum disorders, but as a modifiable exposure, opens the door to thinking about possible preventative measures."

*Other HSPH authors of the study included lead author Raanan Raz, visiting scientist in the Department of Environmental Health; Andrea Roberts, research associate in the Department of Social and Behavioral Sciences; Kristen Lyall, visiting scientist; Jaime Hart, instructor, Department of Environmental Health and Department of Epidemiology at HSPH and assistant professor of medicine, Channing Division of Network Medicine, Brigham and Women's Hospital and Harvard Medical School; Allan Just, research fellow in the Department of Environmental Health; and Francine Laden, Mark and Catherine Winkler Associate Professor of Environmental Epidemiology.*

*Funding for the study came from the Environment and Health Fund (Israel), NIH grants P30 ES000002, R01 ES017017, and U01 CA176726, US Department of Defense grant W81XWH-08-1-0499, grant 1788 from the Autism Speaks Foundation.*

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## Kepler proves it can still find planets

*To paraphrase Mark Twain, the report of the Kepler spacecraft's death was greatly exaggerated.*

Despite a malfunction that ended its primary mission in May 2013, Kepler is still alive and working. The evidence comes from the discovery of a new super-Earth using data collected during Kepler's "second life."

"Like a phoenix rising from the ashes, Kepler has been reborn and is continuing to make discoveries. Even better, the planet it found is ripe for follow-up studies," says lead author Andrew Vanderburg of the Harvard-Smithsonian Center for Astrophysics (CfA).

NASA's Kepler spacecraft detects planets by looking for transits, when a star dims slightly as a planet crosses in front of it. The smaller the planet, the weaker the dimming, so brightness measurements must be exquisitely precise. To enable that precision, the spacecraft must maintain a steady pointing.

Kepler's primary mission came to an end when the second of four reaction wheels used to stabilize the spacecraft failed. Without at least three functioning reaction wheels, Kepler couldn't be pointed accurately.

Rather than giving up on the plucky spacecraft, a team of scientists and engineers developed an ingenious strategy to use pressure from sunlight as a virtual reaction wheel to help control the spacecraft. The resulting second mission, K2, promises to not only continue Kepler's search for other worlds, but also introduce new opportunities to observe star clusters, active galaxies, and supernovae.

Due to Kepler's reduced pointing capabilities, extracting useful data requires sophisticated computer analysis. Vanderburg and his colleagues developed specialized software to correct for spacecraft movements, achieving about half the photometric precision of the original Kepler mission. Kepler's new life began with a 9-day test in February 2014. When Vanderburg and his colleagues analyzed that data, they found that Kepler had detected a single planetary transit.

They confirmed the discovery with radial velocity measurements from the HARPS-North spectrograph on the Telescopio Nazionale Galileo in the Canary Islands. Additional transits were weakly detected by the Microvariability and Oscillations of STars (MOST) satellite.

The newfound planet, HIP 116454b, has a diameter of 20,000 miles, two and a half times the size of Earth. HARPS-N showed that it weighs almost 12 times as much as Earth. This makes HIP 116454b a super-Earth, a class of planets that doesn't exist in our solar system. The average density suggests that this planet is either a water world (composed of about three-fourths water and one-fourth rock) or a mini-Neptune with an extended, gaseous atmosphere.



This close-in planet circles its star once every 9.1 days at a distance of 8.4 million miles. Its host star is a type K orange dwarf slightly smaller and cooler than our sun. The system is 180 light-years from Earth in the constellation Pisces. Since the host star is relatively bright and nearby, follow-up studies will be easier to conduct than for many Kepler planets orbiting fainter, more distant stars. "HIP 116454b will be a top target for telescopes on the ground and in space," says Harvard astronomer and co-author John Johnson of the CfA.

[http://www.eurekalert.org/pub\\_releases/2014-12/cifa-1f121614.php](http://www.eurekalert.org/pub_releases/2014-12/cifa-1f121614.php)

### **'Deep learning' finds autism, cancer mutations in unexplored regions of the genome**

*Scientists and engineers have built a computer model that has uncovered disease-causing mutations in large regions of the genome that previously could not be explored.*

Their method seeks out mutations that cause changes in 'gene splicing,' and has revealed unexpected genetic determinants of autism, colon cancer and spinal muscular atrophy. CIFAR Senior Fellow Brendan Frey (University of Toronto) is the lead author on a paper describing this work, which appears in the Dec. 18 edition of Science Express. The paper was co-authored by CIFAR senior fellows Timothy Hughes (University of Toronto) and Stephen Scherer (The Hospital for Sick Children and the University of Toronto) of the Genetic Networks program. Frey is appointed to the Genetic Networks program, and the Neural Computation & Adaptive Perception program. The research combines the latter groups' pioneering work on deep learning with novel techniques in genetics.

Most existing methods examine mutations in segments of DNA that encode protein, what Frey refers to as low-hanging fruit. To find mutations outside of those segments, typical approaches such as genome wide association studies take disease data and compare the mutations of sick patients to those of healthy patients, seeking out patterns. Frey compares that approach to lining up all the books your child likes to read and looking for whether a particular letter occurs more frequently than in other books.

"It doesn't work, because it doesn't tell you why your kid likes the book," he says. "Similarly, genome-wide association studies can't tell you why a mutation is problematic."

But looking at splicing can. Splicing is important for the vast majority of genes in the human body. When mutations alter splicing, genes may produce no protein, the wrong one or some other problem, which could lead to disease.

Frey's team, which includes researchers from engineering, biology and medicine, developed a computer model that mimics how the cell directs splicing by

detecting patterns within DNA sequences, called the 'splicing code'. They then used their system to examine mutated DNA sequences and determine what effects the mutations would have, effectively scoring each mutation. Unlike existing methods, their technique provides an explanation for the effect of a mutation and it can be used to find mutations outside of segments that code for protein.

To develop the computer model, Frey's team fed experimental data into machine learning algorithms, so as to teach the computer how to examine a DNA sequence and output the splicing pattern.

Their method works surprisingly well and has led to new discoveries. For example, using DNA sequences from five patients with autism provided by Scherer, the model was able to identify 39 new genes that could be implicated in autism spectrum disorder, a 40 per cent increase from about 100 previously known autism genes.

"Brendan's work is groundbreaking because it represents a first serious attempt to decode the portions of that 98 per cent of the human genome outside the genes that are typically studied in genetic disease studies," Scherer says. "This is particularly exciting since it is thought these segments of DNA may contain much of the missing information that we have been looking for in studies like autism." Scherer and Frey began collaborating at CIFAR meetings five years ago and they intend to use this model to analyze the genomes of 10,000 families with autism as part of the MSSNG study. The paper also sheds light on the genetic mechanisms that lead to spinal muscular atrophy, a leading cause of infant death, and nonpolyposis colorectal cancer.

Frey says his involvement in two CIFAR programs was crucial in making connections and in developing interdisciplinary expertise among his graduate students and postdoctoral fellows, including co-authors Hui Xiong, Babak Alipanahi, Leo Lee and Hannes Bretschneider. Also involved were Ben Blencowe of the University of Toronto and Nebojsa Jojic of Microsoft Research.

"My participation in the Neural Computation & Adaptive Perception program enabled my group to have access to the best techniques in deep learning," Frey says. He adds that his interactions with members of the Genetic Networks program challenged him to take on some of the toughest questions in genetics. CIFAR Senior Fellow Frederick Roth, co-director of the program in Genetic Networks, says Drs. Frey, Scherer and Hughes have been key members of the program and its efforts to interpret the genome. "Many of us will soon know our complete human genome sequence, which will be like having an encyclopedic guide to ourselves that is written in an alien language. This work promises to interpret the impact of mutations in a broader region of our genome than has been previously possible," he says.

[http://www.eurekalert.org/pub\\_releases/2014-12/slu-srf121814.php](http://www.eurekalert.org/pub_releases/2014-12/slu-srf121814.php)

## SLU research finds enzyme inhibitors suppress herpes simplex virus replication

*Investigators find different mechanism to fight herpes virus from what is currently on the market*

ST. LOUIS - Saint Louis University research findings published in the December issue of Antimicrobial Agents and Chemotherapy report a family of molecules known as nucleotidyltransferase superfamily (NTS) enzyme inhibitors are promising candidates for new herpes virus treatments.

The findings could lead to new treatment options for herpes that patients can use in conjunction with or instead of currently approved anti-viral medications like Acyclovir. Researcher Lynda A. Morrison Ph.D., professor of Molecular Microbiology and Immunology at Saint Louis University, likened a combination of treatments for herpes to a cocktail of medications HIV patients take.

"Acyclovir does a good job in suppressing the virus," Morrison said. "But because NTS inhibitors work by a different mechanism than currently approved drugs, we have the potential to have a drug that would work in combination with drugs that are already available to completely suppress the virus."

Lead author John E. Tavis, Ph.D., professor of Molecular Microbiology and Immunology at Saint Louis University, noted the findings, which first appeared online in September, have already received interest from pharmacology firms. "Within a decade or so, we could have therapies that reasonably improve patient outcomes," Tavis said. "Improved outcomes could range from shorter duration of nuisance outbreaks (including cold sores) to a better treatment for herpetic encephalitis."

Herpes simplex virus (HSV)encephalitis is thought to occur from direct transmission of the virus to the brain via the nerves that transmit one's sense of sight or facial motor functions like chewing or biting.

The study's authors note that more than half of all Americans are impacted by cold sores (HSV-1) and 20 percent suffer from genital herpes (HSV-2). Herpes can be passed from mother to child during childbirth posing serious health risks to both the baby and the new mother. HSV-2 also increases the risk of human immunodeficiency virus (HIV) acquisition.

The research team at Saint Louis University investigated whether inhibitors of NTS enzymes would suppress replication of HSV-1 and HSV-2. The inhibitors suppressed accumulation of viral genomes and infectious particles and blocked events in the viral replication cycle before and during viral DNA replication.

Five of six NTS inhibitors of the HSVs also blocked replication of another herpes virus pathogen, human cytomegalovirus.

Tavis added that the team is now focused on expanding their original small scale study to identify the exact mechanisms by which each inhibitor suppresses virus replication. He noted that one compound has already proven effective in animals and another is found in a topical antifungal already FDA approved for use. Researchers will also look at the evolution of the virus as it interacts with the inhibitors identified in the study.

"The hope is that it evolves really slowly," Tavis said. "That gives us a better chance at something that can work for a long time without allowing the virus to mutate as rapidly as currently approved treatments do."

Current treatment of herpes infections relies primarily on nucleoside analog inhibitors of the viral DNA polymerase, according to the article. Several newer agents are in clinical development, but none of them have been shown to fully suppress herpes infections.

*Other authors include Hong Wang, Ann E. Tollefson, Baoling Ying, Maria Korom, Xiaohong Cheng, Feng Cao, Katie L. Davis and William S.M. Wold of the Department of Molecular Microbiology and Immunology at Saint Louis University School of Medicine.*

*Morrison and Tavis hold a U.S. patent application that covers the inhibitors they investigated. The work was funded by seed grants from the Saint Louis University Department of Molecular Microbiology and Immunology, the Friends of the Saint Louis University Liver Center and the Saint Louis University School of Medicine.*

[http://www.eurekalert.org/pub\\_releases/2014-12/tl-tlm121714.php](http://www.eurekalert.org/pub_releases/2014-12/tl-tlm121714.php)

## Most commonly prescribed glaucoma drug reduces risk of vision loss by more than 50 percent over 2 years

*Prostaglandin analogue eye drops greatly reduce risk of vision loss in people with open angle glaucoma*

Prostaglandin analogue eye drops, the most commonly prescribed treatment for glaucoma, can greatly reduce risk of vision loss in people with open angle glaucoma (OAG), one of the leading causes of blindness, according to the first placebo-controlled trial to assess their vision-preserving effect published in The Lancet.

"Medication to lower raised eye pressure has been used for decades as the main treatment for OAG to delay progressive vision loss. But, until now, the extent to which the most frequently prescribed class of pressure-lowering drugs (prostaglandin analogues) have a protective effect on vision was not known" \*, explains David Garway-Heath, lead author and International Glaucoma Association Professor of Ophthalmology at the NIHR Biomedical Research

Centre at Moorfields Eye Hospital and UCL Institute of Ophthalmology, London, UK.

"Our findings offer solid proof to patients and practitioners that the visual deterioration caused by glaucoma can be reduced using this treatment."\*

OAG is the most common form of glaucoma affecting more than 550000 people in England and Wales and about 45 million worldwide, projected to increase to 53 million in 2020 and 80 million in 2040<sup>[1]</sup>. Vision loss from glaucoma occurs when the optic nerve is damaged. In most cases, increased pressure inside the eye (intraocular pressure), is thought to contribute to this damage.

The United Kingdom Glaucoma Treatment Study (UKGTS) recruited 516 newly diagnosed, previously untreated individuals with OAG from 10 hospitals across the UK.

Half were randomly assigned to daily pressure-lowering eye drops (latanoprost 0.005%) and the other half to a matching placebo. Over the course of 2 years, participants underwent frequent visual field tests to identify glaucoma deterioration to an extent that would not be noticed by the patient.

In the 59 patients in the placebo group and 35 patients in the latanoprost group whose vision deteriorated during the study period, the risk of visual deterioration was over 50% lower in the group treated with daily pressure-lowering eye drops compared to those using placebo drops over 2 years. Importantly, a significant difference in treatment effects could be seen between the groups after just 12 months. Eighteen serious adverse events were reported (9 in the placebo group and 9 in the latanoprost group) but none were viewed as related to latanoprost. According to Professor Garway-Heath, "Normally, observation periods in trials are at least 5 years. We have shown that with more frequent testing, data can be collected using shorter observation periods. This will bring considerable benefits including speeding up novel drug development, reducing costs, and increasing the likelihood of bringing new drugs to patients."\*

Writing in a linked Comment, Dr Anders Heijl from Lund University, Malmö, Sweden, points out, "Since modern glaucoma treatment is based on reduction of intraocular pressure, and because glaucoma management uses about 25% of all ophthalmology resources, this is a fundamental issue in ophthalmic care...These results should motivate careful clinical follow-up and monitoring of disease progression in patients with glaucoma, and should also serve as a stimulus to the pharmaceutical industry to continue development of new and even more potent drugs."

*The research was funded by Pfizer and the UK National Institute for Health Research Biomedical Research Centre*

*\*Quotes direct from author and cannot be found in text of Article.*

<sup>[1]</sup> [http://www.journalslibrary.nihr.ac.uk/\\_data/assets/pdf\\_file/0011/64676/FullReport-hal11410.pdf](http://www.journalslibrary.nihr.ac.uk/_data/assets/pdf_file/0011/64676/FullReport-hal11410.pdf) and [http://www.aaojournal.org/article/S0161-6420\(14\)00433-3/abstract](http://www.aaojournal.org/article/S0161-6420(14)00433-3/abstract)  
[http://www.eurekalert.org/pub\\_releases/2014-12/udg-aco121514.php](http://www.eurekalert.org/pub_releases/2014-12/udg-aco121514.php)

## **A change of diet to unmask cancer vulnerabilities and reduce cancer risk**

### ***Scientists find unexpected benefit of change of diet on certain types of lung cancer and decipher the molecular mechanism behind this dietary effect***

Many recent studies showed that calorie restrictions reduce the incidence of cancer, whereas high-calorie diets cause obesity and diabetes, both of which increase the risk of developing cancers. However, tumor biology still hides complex mechanisms, as revealed by researchers from the Faculty of Medicine of the University of Geneva (UNIGE), Switzerland. In a study published in *Cell Metabolism*, scientists not only found the unexpected benefit that a change of diet had on certain types of lung cancer, they also deciphered the molecular mechanism underlying this dietary effect and showed how this cancer vulnerability could be exploited in targeted treatment strategies with limited side effects.

Unlike tumors caused by other oncogenes, KRAS-driven tumors, an oncogenic mutation common in lung, pancreas and colon cancers, are known to be sensitive to dietary restrictions. Although the effect of calorie restriction on these tumors is widely studied, Professor Roberto Coppari and his team from the Department of Cell Physiology and Metabolism at UNIGE's Faculty of Medicine, with colleagues from the University of Texas Southwestern Medical Center and from the Ancona University, decided to explore what would the outcomes of a change of diet be (from low to high-calorie diet). Surprisingly, they discovered that a high-calorie diet could have a potent anti-tumor action if the switch of diet took place before the tumor onset. Conversely, a high-calorie diet started after the tumor onset fueled tumor growth and worsened prognosis. The fact that the moment of dietary change is crucial indicates that this effect is not due to the diet per se but to the metabolic changes it engenders. "Our study does not show that, by eating junk food, people would be protected from lung cancer. But the high-calorie diet helped us discover a very specific molecular mechanism required for lung tumor cells to proliferate that could pave the way for new therapeutic approaches", underlines Giorgio Ramadori, the study's co-first author with Georgia Konstantinidou.

### **A matter of thresholds**

In normally functioning cells, a particular kind of molecules - called chaperones - helps proteins to fold and function properly. However, in case of protein overload, chaperone expression increases, with the goal of reducing the likelihood of



proteins being unable to function correctly. In the endoplasmic reticulum (the part of the cells that allows proteins to be properly sorted), when protein overload is achieved, endoplasmic reticulum stress (ER stress) occurs, which involves an increased chaperone expression. When this stress is too high, however, cells cannot cope with it and die. In tumors, the ER stress threshold is different and, in some cases, it seems higher, which constitutes a possible explanation for the fact that they do not die, but can proliferate abnormally even in these circumstances. The scientists discovered that the dietary change was actually a way to trigger a raise in the ER stress. Indeed, if the ER stress threshold is raised before the tumor onset, the sick cells do not have the ability to trigger an effective response and tumor progression is hampered. However, if the change took place after the tumor appeared, tumor cells already resolved a good part of ER stress and the additional stress may actually fuel the proliferation phenomenon.

#### **A potential cancer treatment with limited side effects**

Reducing side effects is a major goal for achieving improved cancer therapy, as quite often treatment kills indiscriminately sick and healthy cells alike. By undertaking transcriptome analyses of lung tumors from the different dietary groups, the scientists identified a specific chaperone protein, FKBP10, of which expression was greatly reduced by a switch to a high-calorie diet. This protein was expressed in human lung cancer cells but not in the healthy ones. Very interestingly, this same protein is usually expressed during the embryonic development and early age, but not in adults (in mice and most likely in human beings). When the embryo is developing, it induces an important ER stress, which is resolved, in part, by these chaperones. After the development phase, the ER stress diminishes greatly. Hence, several chaperones, including FKBP10, are not needed any longer and stop being expressed; tumors, however, reactivate the expression of the FKBP10 protein, probably to cope with their ER stress. An inhibitor to FKBP10 would therefore act as a therapeutic agent able to selectively hinder cancer cell proliferation while sparing healthy lung.

"FKBP10 was not previously thought to be important for cancerous cells. In this study we show that knock-down of FKBP10 leads to reduced cancer growth. Human lung cancer cells express FKBP10 while the nearby healthy lung tissue does not; this is very interesting and appealing to eventually translate these findings to the clinical arena. Hence, if we manage to identify the right inhibitor, we may open the door to new therapeutic strategies that will be able to hinder cancer cells proliferation without damaging the healthy cells. The inhibition of this protein is predicted to have minimal side effects as it is not expressed in healthy tissues, at least in adulthood," concludes Roberto Coppari, who estimates

that, if preclinical data support such expectation, clinical trials could start in a few years' time.

<http://phys.org/news/2014-12-nasa-possibilities-mission-venus.html>

### **NASA considers possibilities for manned mission to Venus**

#### *A possible way for humans to visit Venus, rather than Mars*

by Bob Yirka in Astronomy & Space / Space Exploration

Phys.org - NASA's Systems Analysis and Concepts Directorate has issued a report outlining a possible way for humans to visit Venus, rather than Mars—by hovering in the atmosphere instead of landing on the surface. The hovering vehicle, which they call a High Altitude Venus Operational Concept (HAVOC), would resemble a blimp with solar panels on top, and would allow people to do research just 50 kilometers above the surface of the planet.

Most everyone knows that NASA wants to send people to Mars—that planet also gets most of the press. Mars is attractive because it looks more like Earth and is relatively close to us. The surface of Venus on the other hand, though slightly closer, is not so attractive, with temperatures that can melt lead and atmospheric pressure 92 times that of Earth. There's also that thick carbon dioxide atmosphere with sulfuric acid clouds, lots of earthquakes, volcanoes going off and terrifying lightning bolts. So, why would anyone rather go to Venus than Mars? Because of far lower radiation and much better solar energy.

No one wants to go the surface of Venus, at least not anytime soon, instead, researchers at NASA are looking into the possibility of sending people to hover in the sky above the planet, conducting research in a far less dangerous place than even on the surface of Mars. At 50 kilometers up, an HAVOC would experience just one atmosphere of atmospheric pressure and temperatures averaging just 75 degrees Celsius, with radiation levels equivalent to those in Canada. Astronauts on Mars, on the other hand would experience 40 times the amount of radiation typically faced back here on Earth, which suggests they'd have to live deep underground to survive—a problem that scientists have not yet solved.

The one hitch to floating around Venus, would of course be, figuring out how to get both humans and an HAVOC to the planet, and then for getting the humans back home safely to Earth at some point. The initial plans call for a several missions, building up to the final, with space ships first carrying unmanned vehicles to test the concept of an HAVOC, followed by missions where humans would orbit the planet in space. Next, scientists would have to come up with a feasible design for deploying a floating vehicle able to unfurl, fill itself with gas, and hover for long stretches of time in the sky above the planet. After that, vehicles would have to be designed to work with such a craft, to serve as a ferry between the HAVOC and an orbiting craft, to travel back and forth to Earth, and

perhaps between a craft that orbits Earth and the surface. A lot of work, no doubt, but one that seems possible even as more and more space scientists are beginning to wonder about the feasibility of sending humans to the surface of Mars.

[http://www.eurekalert.org/pub\\_releases/2014-12/bsi-asd121814.php](http://www.eurekalert.org/pub_releases/2014-12/bsi-asd121814.php)

### **A\*STAR scientists discover gene critical for proper brain development**

*This gene accounts for the size of the human brain and potentially our superior cognitive abilities*

Scientists at A\*STAR's Institute of Medical Biology (IMB) and Institute of Molecular and Cellular Biology (IMCB) have identified a genetic pathway that accounts for the extraordinary size of the human brain. The team led by Dr Bruno Reversade from A\*STAR in Singapore, together with collaborators from Harvard Medical School, have identified a gene, KATNB1, as an essential component in a genetic pathway responsible for central nervous system development in humans and other animals.

By sequencing the genome of individuals of normal height but with a very small head size, the international team revealed that these individuals had mutations in the KATNB1 gene, indicating that this gene is important for proper human brain development. Microcephaly (literally meaning "small head" in Latin) is a condition often associated with neurodevelopmental disorders. Measured at birth by calculating the baby's head circumference, a diagnosis of microcephaly is given if it is smaller than average.

Microcephaly may stem from a variety of conditions that cause abnormal growth of the brain during gestation or degenerative processes after birth, all resulting in a small head circumference. In general, individuals with microcephaly have a reduced life expectancy due to reduced brain function which is often associated with mental retardation.

The team also carried out further experiments to determine the function of KATNB1, whose exact mode of action was previously unknown in humans. Using organisms specifically designed to lack this gene, they realised that KATNB1 is crucial for the brain to reach its correct size. Zebrafish and mice embryos without this gene could not live past a certain stage and showed dramatic reduction in brain and head size, similar to the human patients. Their results were published in the 17 December 2014 online issue of *Neuron*, the most influential journal in the field of Neuroscience.

Sequencing and screening for this particular gene before birth or at birth might also help to detect future neurocognitive problems in the general population. Dr Reversade said, "We will continue to search for other genes important for brain

development as they may unlock some of the secrets explaining how we, humans, have evolved such cognitive abilities."

Prof Birgit Lane, Executive Director of IMB, said, "This is one of a small number of genes that scientists have found to be vital for brain development. The work is therefore an important advance in understanding the human brain. The team's findings provide a new platform from which to look further into whether - and how - this gene can be used for targeted therapeutic applications."

Prof Hong Wanjin, Executive Director of IMCB, said, "This coordinated effort shows the increasingly collaborative nature of science. As the complexity and interdisciplinary nature of research evolves, so do the networks of collaborations between research institutes at A\*STAR and across continents."

*The research findings described in this media release can be found in the 17 December online issue of Neuron, Cell Press under the title, "Katanin p80 Regulates Human Cortical Development by Limiting Centriole and Cilia Number" by Wen F. Hu,1,2,3,5,6 Oz Pomp,19 Tawfeg Ben-Omran,12 Andrew Kodani,18 Katrin Henke,4,9 Ganeshwaran H. Mochida,1,2,7,10 Timothy W. Yu,1,7,11 Mollie B. Woodworth,1,2,3,7 Carine Bonnard,19 Grace Selva Raj,19Thong Teck Tan,19 Hanan Hamamy,21 Amira Masri,23 Mohammad Shboul,19 Muna Al Saffar,1,2,13 Jennifer N. Partlow,1,2,3 Mohammed Al-Dosari,17 Anas Alazami,14 Mohammed Alowain,15,16 Fowzan S. Alkuraya,14,16 Jeremy F. Reiter,18 Matthew P. Harris,4,9,24,\* Bruno Reversade,19,20,22,24 and Christopher A. Walsh1,2,3,5,6,7,8,24.*

[http://www.eurekalert.org/pub\\_releases/2014-12/uoc--lmm121914.php](http://www.eurekalert.org/pub_releases/2014-12/uoc--lmm121914.php)

### **Lost memories might be able to be restored, new UCLA study indicates**

*Research reveals that memories may not be stored in synapses, as previously thought*

New UCLA research indicates that lost memories can be restored. The findings offer some hope for patients in the early stages of Alzheimer's disease.

For decades, most neuroscientists have believed that memories are stored at the synapses -- the connections between brain cells, or neurons -- which are destroyed by Alzheimer's disease. The new study provides evidence contradicting the idea that long-term memory is stored at synapses.

"Long-term memory is not stored at the synapse," said David Glanzman, a senior author of the study, and a UCLA professor of integrative biology and physiology and of neurobiology. "That's a radical idea, but that's where the evidence leads. The nervous system appears to be able to regenerate lost synaptic connections. If you can restore the synaptic connections, the memory will come back. It won't be easy, but I believe it's possible." The findings were published recently in *eLife*, a highly regarded open-access online science journal.

Glanzman's research team studies a type of marine snail called *Aplysia* to understand the animal's learning and memory. The *Aplysia* displays a defensive response to protect its gill from potential harm, and the researchers are especially interested in its withdrawal reflex and the sensory and motor neurons that produce it.

They enhanced the snail's withdrawal reflex by giving it several mild electrical shocks on its tail. The enhancement lasts for days after a series of electrical shocks, which indicates the snail's long-term memory. Glanzman explained that the shock causes the hormone serotonin to be released in the snail's central nervous system.

Long-term memory is a function of the growth of new synaptic connections caused by the serotonin, said Glanzman, a member of UCLA's Brain Research Institute. As long-term memories are formed, the brain creates new proteins that are involved in making new synapses. If that process is disrupted -- for example by a concussion or other injury -- the proteins may not be synthesized and long-term memories cannot form. (This is why people cannot remember what happened moments before a concussion.)

"If you train an animal on a task, inhibit its ability to produce proteins immediately after training, and then test it 24 hours later, the animal doesn't remember the training," Glanzman said. "However, if you train an animal, wait 24 hours, and then inject a protein synthesis inhibitor in its brain, the animal shows perfectly good memory 24 hours later. In other words, once memories are formed, if you temporarily disrupt protein synthesis, it doesn't affect long-term memory. That's true in the *Aplysia* and in human's brains." (This explains why people's older memories typically survive following a concussion.)

Glanzman's team found the same mechanism held true when studying the snail's neurons in a Petri dish. The researchers placed the sensory and motor neurons that mediate the snail's withdrawal reflex in a Petri dish, where the neurons re-formed the synaptic connections that existed when the neurons were inside the snail's body. When serotonin was added to the dish, new synaptic connections formed between the sensory and motor neurons. But if the addition of serotonin was immediately followed by the addition of a substance that inhibits protein synthesis, the new synaptic growth was blocked; long-term memory could not be formed. The researchers also wanted to understand whether synapses disappeared when memories did. To find out, they counted the number of synapses in the dish and then, 24 hours later, added a protein synthesis inhibitor. One day later, they re-counted the synapses.

What they found was that new synapses had grown and the synaptic connections between the neurons had been strengthened; late treatment with the protein

synthesis inhibitor did not disrupt the long-term memory. The phenomenon is extremely similar to what happens in the snail's nervous system during this type of simple learning, Glanzman said.

Next, the scientists added serotonin to a Petri dish containing a sensory neuron and motor neuron, waited 24 hours, and then added another brief pulse of serotonin -- which served to remind the neurons of the original training -- and immediately afterward add the protein synthesis inhibitor. This time, they found that synaptic growth and memory were erased. When they re-counted the synapses, they found that the number had reset to the number before the training, Glanzman said. This suggests that the "reminder" pulse of serotonin triggered a new round of memory consolidation, and that inhibiting protein synthesis during this "reconsolidation" erased the memory in the neurons.

If the prevailing wisdom were true -- that memories are stored in the synapses -- the researchers should have found that the lost synapses were the same ones that had grown in response to the serotonin. But that's not what happened: Instead, they found that some of the new synapses were still present and some were gone, and that some of the original ones were gone, too.

Glanzman said there was no obvious pattern to which synapses stayed and which disappeared, which implied that memory is not stored in synapses.

When the scientists repeated the experiment in the snail, and then gave the animal a modest number of tail shocks -- which do not produce long-term memory in a naive snail -- the memory they thought had been completely erased returned. This implies that synaptic connections that were lost were apparently restored.

"That suggests that the memory is not in the synapses but somewhere else," Glanzman said. "We think it's in the nucleus of the neurons. We haven't proved that, though."

Glanzman said the research could have significant implications for people with Alzheimer's disease. Specifically, just because the disease is known to destroy synapses in the brain doesn't mean that memories are destroyed.

"As long as the neurons are still alive, the memory will still be there, which means you may be able to recover some of the lost memories in the early stages of Alzheimer's," he said. Glanzman added that in the later stages of the disease, neurons die, which likely means that the memories cannot be recovered.

The cellular and molecular processes seem to be very similar between the marine snail and humans, even though the snail has approximately 20,000 neurons and humans have about 1 trillion. Neurons each have several thousand synapses.

Glanzman used to believe that traumatic memories could be erased but he has changed his mind. He now believes that, because memories are stored in the



nucleus, it may be much more difficult to modify them. He will continue to study how the marine snail's memories are restored and how synapses re-grow.

Co-authors of the study include Shanping Chen, Diancai Cai and Kaycey Pearce, research associates in Glanzman's laboratory.

The research was funded by the National Institutes of Health's National Institute of Neurological Disorders and Stroke, the National Institute of Mental Health and the National Science Foundation.

Almost all the processes that are involved in memory in the snail also have been shown to be involved in memory in the brains of mammals, Glanzman said. In a 1997 study published in the journal *Science*, Glanzman and colleagues identified a cellular mechanism in the *Aplysia* that plays an important role in learning and memory. A protein called N-methyl D-aspartate, or NMDA, receptor enhances the strength of synaptic connections in the nervous system and plays a vital role in memory and in certain kinds of learning in the mammalian brain as well. Glanzman's demonstration that the NMDA receptor plays a critical role in learning in a simple animal like the marine snail was entirely unexpected at the time.

<http://phys.org/news/2014-12-fully-automated-thousands-blood-samples.html>

### **Fully automated: Thousands of blood samples every hour**

***Siemens is supplying automation technology for the longest and one of the most cutting-edge sample processing lines in any clinical laboratory.***

Siemens is supplying automation technology for the longest and one of the most cutting-edge sample processing lines in any clinical laboratory. The line, or automation track, 200 meters long, in Marlborough, Massachusetts, is the heart of the "Lab of the Future," with which Quest Diagnostics, a leading laboratory service provider in the US and worldwide, is aiming to set new standards for the industry. Once completed in 2015, the automation solution will be able to process several thousand blood samples every hour.

Automation specialists from the Chemistry, Immunoassay, Automation and Diagnostics IT Business Unit of the Diagnostics Division of Siemens Healthcare are designing and installing this solution in conjunction with automation provider Inpeco. The new track combines many areas of blood sample testing as part of a comprehensive system, from sample feed through to storage.

This automation solution increases sample throughput, reducing the need for manual work and thus reducing the risk of errors. It also reduces the processing time for each sample, resulting in a substantial productivity gain for the laboratory. The challenge in designing such a comprehensive automation system lies in bringing together the many different work processes and areas of testing that are performed in a laboratory. This one-of-a-kind, fully customized Siemens

automation solution integrates and optimizes the many critical tasks of a clinical laboratory into a single line.

### **Refrigeration unit for up to 500,000 samples**

The system fully automates the processing of unsorted test tubes, regardless of content - blood, urine, serum -using bar code labels. Robot arms place the sample containers on multi-lane conveyor belts that transport them to the appropriate diagnostic stations. Also, should a customer need it, Siemens automation solution can prioritize urgent samples for emergency cases and automatically convey them on a sort of "passing lane," moving them quickly to the front of the line. At the analysis stations, pipettes draw the volume of sample required in each case, which means there is no longer any need to split a sample between several test tubes, which has previously been standard. The measurement data for each sample and its current position in the line can be called up at any time and it is possible to see when all the results will be available. Storage is also fully automated, to ensure that the right sample is always available when required.

The Lab of the Future is precisely tailored to the demands of Quest Diagnostics. For example, it must be able to incorporate additional instruments from other manufacturers into the line at any time. A further new aspect was the size of the refrigeration unit, which accommodates up to 500,000 samples. Siemens and Inpeco will be the preferred providers should Quest Diagnostics want to implement a comparable automation solution in its other clinical laboratories

<http://bit.ly/1E1LHkW>

### **Scientists Find Evidence of Previously Unrecognized Water Reservoir on Mars**

***Scientists Find Meteoritic Evidence of Mars Water Reservoir***

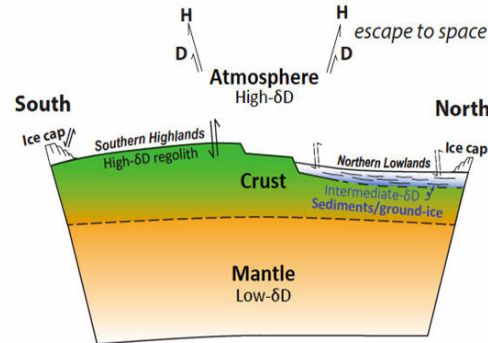
**Dwayne Brown, NASA Headquarters**

A newly published study provides evidence for a previously unrecognized hydrogen reservoir on Mars, which could account for a large part of the initial water budget of Mars. NASA and an international team of planetary scientists have found evidence in meteorites on Earth that indicates Mars has a distinct and global reservoir of water or ice near its surface.

Though controversy still surrounds the origin, abundance and history of water on Mars, this discovery helps resolve the question of where the "missing Martian water" may have gone. Scientists continue to study the planet's historical record, trying to understand the apparent shift from an early wet and warm climate to today's dry and cool surface conditions.

The reservoir's existence also may be a key to understanding climate history and the potential for life on Mars. The team's findings are reported in the journal *Earth and Planetary Science Letters*.

“There have been hints of a third planetary water reservoir in previous studies of Martian meteorites, but our new data require the existence of a water or ice reservoir that also appears to have exchanged with a diverse set of Martian samples,” said Tomohiro Usui of Tokyo Institute of Technology in Japan, lead author of the paper and a former NASA/Lunar and Planetary Institute postdoctoral fellow. “Until this study there was no direct evidence for this surface reservoir or interaction of it with rocks that have landed on Earth from the surface of Mars.”



***This illustration depicts Martian water reservoirs. Recent research provides evidence for the existence of a third reservoir that is intermediate in isotopic composition between the Red Planet’s mantle and its current atmosphere. These results support the hypothesis that a buried cryosphere accounts for a large part of the initial water budget of Mars.***

Researchers from the Tokyo Institute of Technology, the Lunar and Planetary Institute in Houston, the Carnegie Institution for Science in Washington and NASA’s Astromaterials Research and Exploration Science Division, located at the agency’s Johnson Space Center in Houston, studied three Martian meteorites. The samples revealed water comprised of hydrogen atoms that have a ratio of isotopes distinct from that found in water in the Red Planet’s mantle and current atmosphere. Isotopes are atoms of the same element with differing numbers of neutrons.

While recent orbiter missions have confirmed the presence of subsurface ice, and melting ground-ice is believed to have formed some geomorphologic features on Mars, this study used meteorites of different ages to show that significant ground water-ice may have existed relatively intact over time.

Researchers emphasize that the distinct hydrogen isotopic signature of the water reservoir must be of sufficient size that it has not reached isotopic equilibrium with the atmosphere.

“The hydrogen isotopic composition of the current atmosphere could be fixed by a quasi-steady-state process that involves rapid loss of hydrogen to space and the sublimation from a widespread ice layer,” said coauthor John Jones, a JSC experimental petrologist and member of NASA’s Mars Curiosity rover team. Curiosity’s observations in a lakebed, in an area called Mount Sharp, indicate Mars lost its water in a gradual process over a significant period of time.

“In the absence of returned samples from Mars, this study emphasizes the importance of finding more Martian meteorites and continuing to study the ones we have with the ever-improving analytical techniques at our disposal,” said co-author Conel Alexander, a cosmochemist at the Carnegie Institution for Science. In this investigation, scientists compared water, other volatile element concentrations and hydrogen isotopic compositions of glasses within the meteorites, which may have formed as the rocks erupted to the surface of Mars in ancient volcanic activity or by impact events that hit the Martian surface, knocking them off the planet.

“We examined two possibilities, that the signature for the newly identified hydrogen reservoir either reflects near surface ice interbedded with sediment or that it reflects hydrated rock near the top of the Martian crust,” said coauthor and JSC cosmochemist Justin Simon. “Both are possible, but the fact that the measurements with higher water concentrations appear uncorrelated with the concentrations of some of the other measured volatile elements, in particular chlorine, suggests the hydrogen reservoir likely existed as ice.” The information being gathered about Mars from studies on Earth, and data being returned from a fleet of robotic spacecraft and rovers on and around the Red Planet, are paving the way for future human missions on a journey to Mars in the 2030s.

*Publication: Tomohiro Usui, et al., “Meteoritic evidence for a previously unrecognized hydrogen reservoir on Mars,” Earth and Planetary Science Letters, Volume 410, 15 January 2015, Pages 140–151; doi:10.1016/j.epsl.2014.11.022*

<http://bit.ly/1x2dxHy>

## **Bio Bigwigs Go after Drugs for Parkinson’s, Alzheimer’s and ALS**

***Diseases of the brain have yet to experience the kind of recent advances that are now altering prognoses for hepatitis C or melanoma and some other cancers.***

By Gary Stix | December 19, 2014

Lists of the biggest challenges in brain science often start - or end - with consciousness. “End” because consciousness is considered so overwhelming a hack that it merits coming last on the list—the ultimate challenge. Consciousness probably deserves its first-or-last place of preference. But there is another entry that should be on the list that is frequently left out. Notwithstanding the legions of ebullient, young graduate students entering the field, neuroscience faces the immediate difficulty of finding treatments that can make a fundamental difference in neurodegenerative and psychiatric disorders that all too often beset the subcranial three-pound wonder.

Diseases of the brain have yet to experience the kind of recent advances that are now altering prognoses for hepatitis C or melanoma and some other cancers. The dearth of new solutions for Alzheimer's, Parkinson's, ALS and other neurodegenerative disorders that affect an estimated 50 million globally was one of the reasons that the founding of a new company called Yumanity Therapeutics has drawn some notice.

Tony Coles, who headed cancer-drug maker Onyx Pharmaceuticals when it was sold for about \$10 billion to Amgen last year, wants to tap an emerging research theme that focuses on proteins getting bent out of shape as a critical step in the process of killing brain cells. Misfolded proteins cause a cascading reaction reminiscent of what occurs in prion diseases like Mad Cow, with one protein causing a neighbor to contort. As the process continues, the result ends up as a mess of proteinaceous gunk

Scientific American had an article on this topic last year by Lary Walker of Emory and Matthias Jucker of the Hertie Institute for Clinical Brain Research in Tübingen, Germany. Its introductory blurb trumpeted: "A chain reaction of toxic proteins may help explain Alzheimer's, Parkinson's and other killers—an insight that could lead to desperately needed new treatment options."

Coles wants to couple the cross-cutting insight about misfolded proteins with a research platform developed by Susan Lindquist of the Whitehead Institute for Biomedical Research. A Yumanity co-founder, Lindquist is a world leader in the nuances of protein folding. The company will use Lindquist's technologies to screen for drug candidates in yeast and then test them in neurons derived from stem cells drawn from individuals harboring genetic mutations that predispose them to these illnesses. Finally, the researchers will go back to the yeast to explore how a promising compound works at the molecular level.

There have been a number of long-shot startups recently. Google has funded Calico to take on aging, a goal that overlaps somewhat with Yumanity's mission of tackling diseases like Alzheimer's. But Calico's plan is a bit like creating a marketing plan for the space tourism industry using yet-to-be-developed faster-than-light transport vehicles. Yumanity's bottom-up approach of focusing on the domino effect common to a set of devastating diseases may prove more tractable. For just that reason, the doings of Coles and Lindquist bear watching.

<http://bit.ly/1zUFwex>

## This Dying Star Is the Coldest Place We've Found in the Universe

*The Boomerang Nebula is just one degree above absolute zero*

By [Marissa Fessenden](#)

As winter days grow colder, remember that even when you are shivering and the inside of your nose hurts from the cold air, the temperature is far from that at the

coldest spot in the universe. Maybe there's not much comfort in that, but the honor for most brain-numbingly cold goes to the a nebula shimmering about 5,000 light-years from Earth.

The star at the center of the oddly-shaped object PGC 3074547, variously called the Boomerang Nebula or Bow Tie Nebula, has been shedding gas as it dies. "The gas is cooling as it flows away from the white dwarf star in a process similar to how refrigerators stay cold by using expanding gas," [writes Elizabeth Howell for SPACE.com](#).



*Both the Hubble Space Telescope (blue) and the ALMA Observatory contribute to this image of the Boomerang Nebula* Bill Saxton/NRAO/AUI/NSF/NASA/ Hubble/Raghvendra Sahai

The result is a nebula just barely warmer than [absolute zero](#)—the lowest possible temperature where all atomic motion ceases. It's minus 458 degrees Fahrenheit or 1 degree Kelvin. [Mika McKinnon for io9 reports](#):

*While [we can get incredibly close to absolute zero in lab experiments](#), nothing we've done lasts nearly long enough to be a "place" instead of a brief, chilly moment in time. The Boomerang Nebula is so cold, the only way to measure the temperature is by watching how it absorbed the [cosmic microwave background radiation](#), which is a relatively [almost-toasty 2.8 Kelvin](#).*

The entire nebula is only visible because starlight reflects off its floating dust grains.

But Boomerang will soon lose its "coldest place in the universe" designation. In 2016, NASA plans to launch the Cold Atom Lab, which [io9 reports](#) will be able to plunge down to 1/10 billionth of a degree above absolute zero. "One of the primary goals of this facility will be to explore a previously inaccessible regime of extremely low temperatures where interesting and novel quantum phenomena can be expected," [NASA writes](#).



