http://www.eurekalert.org/pub_releases/2011-07/dumc-aci070611.php

A classic instinct -- salt appetite -- is linked to drug addiction

Durham, N.C., U.S. and Melbourne, Australia -- ***A team of Duke University Medical Center and Australian scientists has found that addictive drugs may have hijacked the same nerve cells and connections in the brain that serve a powerful, ancient instinct: the appetite for salt.***

Their rodent research shows how certain genes are regulated in a part of the brain that controls the equilibrium of salt, water, energy, reproduction and other rhythms – the hypothalamus. The scientists found that the gene patterns activated by stimulating an instinctive behavior, salt appetite, were the same groups of genes regulated by cocaine or opiate (such as heroin) addiction. The study was published in the Proceedings of the National Academy of Sciences early edition online on July 11.

"We were surprised and gratified to see that blocking addiction-related pathways could powerfully interfere with sodium appetite," said co-lead author Wolfgang Liedtke, M.D., Ph.D., an Assistant Professor of Medicine and Neurobiology at Duke University. "Our findings have profound and far-reaching medical implications, and could lead to a new understanding of addictions and the detrimental consequences when obesity-generating foods are overloaded with sodium."

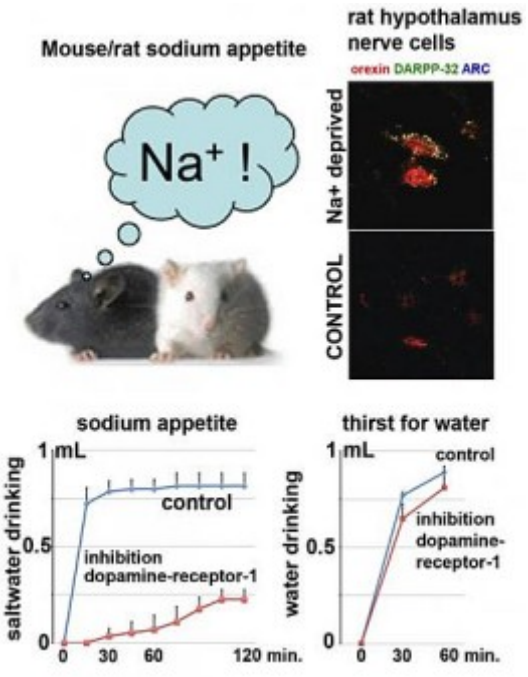
"Though instincts like salt appetite are basically genetic neural programs, they may be substantially changed by learning and cognition," said co-lead author Professor Derek Denton, of the University of Melbourne and the Florey Neuroscience Institute, who is renowned for his pioneering work in the field of instinctive behavior. "Once the genetic program is operating, experiences that are part of the execution of the program become embodied in the overall patterns of an individual's behavior, and some scientists have theorized that drug addiction may use nerve pathways of instinct. In this study, we have demonstrated that one classic instinct, the hunger for salt, is providing neural organization that subserves addiction to opiates and cocaine."

Deeply embedded pathways of an ancient instinct may explain why addiction treatment with the chief objective of abstinence is so difficult, said Denton. Liedtke said that this might be relevant given the appreciable success of maintenance approaches that don't involve abstinence, like replacing heroin with methadone and cigarettes with nicotine gum or patches.

"The work opens new pathways of experimental approach to addiction," Denton said.

The study was the first to examine gene regulation in the hypothalamus for salt appetite. The team used two techniques to induce the instinctive behavior in mice – they withheld salt for a while combined with a diuretic and they also used the stress hormone ACTH to increase salt needs.

Liedtke, who is also affiliated with the Duke Center for Translational Neuroscience and the Duke Pain Clinics, said the researchers were surprised that they could detect that genes were "turned on" or "turned off" in salt appetite, these patterns were often substantially reversed within ten minutes of the animals' drinking salt solution, well before any significant salt could be absorbed from the gut into the bloodstream. The question of how this occurs is perplexing, and opens an entirely new field for exploration, Liedtke said.



Researchers induced salt (Na+) appetite in mice or rats, which led to the discovery of profound changes in certain nerve cells in the hypothalamus (micrographs, upper right). These nerve cells became enlarged and increased their expression of two proteins, DARPP-32 (green) and ARC (blue). These neurons are part of a powerful circuit that sustains addiction behavior, and the increased expression of DARPP-32 and ARC suggests that these neurons more readily respond to reward stimuli. The bright yellow color in these neurons indicates co-localization (the appearance together) of both of those proteins along with orexin, a protein initially linked to appetite stimulation, but in this part of the hypothalamus later found to be critical for addiction-related behaviors. Dopamine-receptor-1 is a nerve-cell-surface receptor protein that signals to the nerve cell that dopamine molecules have attached. One of the effects of dopamine binding to its receptor is that animals, including humans, get a strong reward sensation, which can be coupled to behavioral conditioning -- the binding makes the animal or person want to repeat what led to the dopamine release. Below, the line graphs show that induced salt appetite in mice can be powerfully reduced with drugs that block dopamine-receptor-1, whereas a related instinct, thirst for water, is not affected by such treatment. Wolfgang Liedtke, Duke Departments of Medicine and Neurobiology

In terms of survival advantage of this behavior, fast satisfaction of salt appetite makes sense. Among wild animals, the ability to rapidly compensate for salt need by avidly lapping a salty solution means that depleted animals can drink to gratification and leave quickly, reducing their vulnerability to predators.

The Duke-Melbourne research team found that when the animal harbors a robust sodium appetite, a certain region of the hypothalamus seems to become susceptible to the effects of dopamine, which is the brain's internal currency for reward. That suggests that the state of the instinctive need, the sodium-depleted state, "spring-loads" the hypothalamus for the subjective experience of reward which follows when animals gratify the need – a satisfied feeling. This concept is substantiated by their finding that the local actions of dopamine on a sub-region of the hypothalamus are critical for the animals' instinctive behavior.

Other Duke authors include Hao Zhang, Andreas Pfenning and Sarah Hochendoner. The Melbourne team included Michael McKinley, Andrew Lawrence, John Drago, and Lesley Walker of the Florey Neuroscience Institute. The team also included Donald Hilton of the University of Texas Health Science Center in San Antonio.

Support came from the G. Harold and Leila Y. Mather's Foundation, The Robert J Jr. and Helen C. Kleberg Foundation, the Search Foundation, Ms. Diana Gibson, Mr. Robert Albert, Mr. Baillieu Myer, and Dr. Mark Nelson, the NH&MRC of Australia Fellowship, The Derek Denton Endowment Fund, a Trinity College Undergrad Fellowship, a Robert H. Ebert Clinical Scholarship of the Klingenstein Fund and start-up funds from Duke University.

http://www.eurekalert.org/pub_releases/2011-07/cmaj-acg070511.php

Alcohol consumption guidelines inadequate for cancer prevention

Current alcohol consumption guidelines are inadequate for the prevention of cancer and new international guidelines are needed, states an analysis in CMAJ (Canadian Medical Association Journal)

Guidelines in some countries are not currently based on evidence for long-term harm. Most guidelines are based on studies that assessed the short-term effects of alcohol, such as social and psychological issues and hospital admissions, and were not designed to prevent chronic diseases. As well, in some countries, alcohol producers were either part of working groups defining sensible drinking or instrumental in dissemination of the guidelines.

There is increasing evidence that links alcohol consumption to cancer. The WHO International Agency of Research on Cancer has stated, based on evidence, that alcohol is carcinogenic in both animals and humans. Several evaluations of this agency as well the joint 2007 report of the World Cancer Research Fund and the American Institute for Cancer Research warned of the link between alcohol and cancers in the mouth, throat, esophagus, liver, colon-rectum and breast cancers. Based on the evidence, "there is no level of alcohol consumption for which cancer risk is null."

"On the whole, alcohol is considered an avoidable risk factor for cancer incidence and, more generally, for the global burden of disease," writes Dr. Paule Latino-Martel, French National Institute for Agricultural Research (INRA), with coauthors from the French Institute for Prevention and Health Education (INPES) and the French National Cancer Institute (INCa).

"Although drinking guidelines used in the context of a brief intervention have proven effective" to help people who have problems due to their drinking habits to reduce their alcohol consumption, they are inadequate to prevent all types of risks including cancer risk. Therefore, "their application to the general population should be revisited," write the authors.

Canadian guidelines for "low-risk" consumption, set in 1997 at 9 drinks per week for women and 14 per week for men, may be modified when Canada releases its first national guidelines later in 2011.

"Although guidelines are currently practical for health professionals and health authorities, the time has come to reconsider them using a scientific basis independent of any cultural and economic considerations and to discuss the eventuality of abandoning them," conclude the authors. "Considering our current knowledge of the relationship between alcohol consumption and cancer risk, national health authorities should be aware of the possible legal consequences of promoting drinking guidelines that allow consumers to believe that drinking at low or moderate levels is without risk."

http://www.eurekalert.org/pub_releases/2011-07/bumc-amr071111.php

All-cause mortality rates are lower among moderate drinkers than among abstainers

The author of this paper set out to determine the extent to which potential "errors" in many early epidemiologic studies led to erroneous conclusions about an inverse association between moderate drinking and coronary heart disease (CHD).

His analysis is based on prospective data for more than 124,000 persons interviewed in the U.S. National Health Interview Surveys of 1997 through 2000 and avoids the pitfalls of some earlier studies. He concludes that the so-called "errors" have not led to erroneous results, and that there is a strong protective effect of moderate drinking on CHD and all-cause mortality.

The results of this analysis support the vast majority of recent well-done prospective studies. In the present paper, non-drinkers had much higher risk of death than did almost all categories of subjects consuming alcohol. The author contends that these results lend credence to the argument that the relationship between alcohol and mortality is causal.

While some Forum reviewers felt that this analysis only replicates what has been shown in many other papers, it appears that erroneous information continues to be used by some policy groups in setting drinking guidelines. Thus, most reviewers believe that this new analysis provides important information on potential health effects of moderate drinking.

Reference: Fuller TD. Moderate alcohol consumption and the risk of mortality. Demography 2011. DOI 10.1007/s13524-011-0035-2

http://www.eurekalert.org/pub_releases/2011-07/bmj-cam070811.php

Contact allergies may trigger immune system defences to ward off cancer

Association between cancer and contact allergy: A linkage study 2011

Contact allergies (reactions caused by direct contact with substances like common metals and chemicals) may help prime the immune system to ward off certain types of cancer, suggests research published today in the online only title BMJ Open.

Previous research has indicated that people with type 1 allergies, which include pollen and house dust mites, may be more or less likely to develop cancer. But it is not known if those with contact allergies to common metals such as nickel, and chemicals, might also be afforded protection against the disease.

The authors base their findings on just under 17,000 Danish adults all of whom were patch tested for positivity to the most common contact allergens between 1984 and 2008 at a specialist hospital for skin problems.

The long term health of all the participants was subsequently monitored and cross checked against entries on disease registers, including a national cancer registry.

In all, just over one in three (35%; 6,065) people had a positive reaction to at least one allergen on at least one occasion. The prevalence of reactivity was significantly higher among women, just over 41% of whom "reacted" compared with around one in four (26%) of the men.

Just under one in five people (19%) of all those patch tested had developed a growth, including non-cancerous tumours. And just under 38% of this group had tested positive for contact allergy.

Only cancers affecting at least 40 people were included, and when the data were analysed a strong association emerged between a diagnosis of contact allergy and an entry in the cancer register. And there were significant differences in the prevalence of four cancers between those with and without contact allergies.

There were significantly lower rates of breast and non-melanoma skin cancer in both sexes among those with contact allergies, and lower rates of brain cancer among women.

These findings back up the "immunosurveillance hypothesis," which holds that people with allergies are less likely to develop cancer because their immune systems are super responsive, say the authors.

The analysis also picked up higher rates of bladder cancer found among those with contact allergies, which might be the result of higher levels of chemical metabolites accumulated in the blood, they suggest.

The authors caution that it is too early to draw definitive conclusions about cause and effect. Further analysis, taking account of influential factors, such as smoking and social class, is needed, they suggest.

"However if these relations are aetiological, there are implications for understanding how contact allergy can affect cancer development, and vice versa," they conclude.

http://www.physorg.com/news/2011-07-rna-reactor-precursor-life.html

RNA reactor could have served as a precursor of life

(PhysOrg.com) -- ***Nobody knows quite how life originated on Earth, but most scientists agree that living cells did not abruptly appear from nonliving cells in a single step.***

Instead, there were probably a series of pre-cellular life forms that arose from nonliving chemicals and eventually led to a living cell, one that could undergo metabolism and reproduce. One of the most well-known theories of pre-cellular life is the RNA world theory, which proposes that life based on RNA predates current life, which is based on DNA, RNA, and proteins. But recently, scientists have been wondering what may have preceded RNA. In a new study, a team of scientists from Germany has suggested that the ability to self-replicate may have first emerged in the form of an RNA reactor, which they show can transmit information.

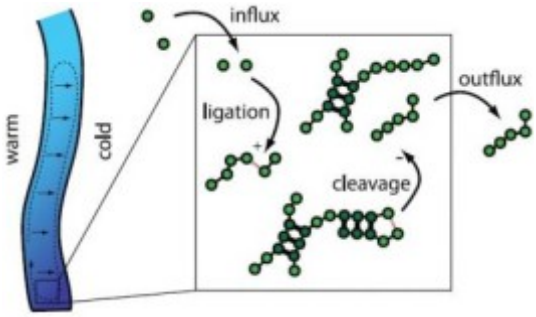
The scientists, Benedikt Obermayer, Hubert Krammer, Dieter Braun, and Ulrich Gerland of the Ludwig Maximilians University of Munich, have published their study on the prebiotic RNA reactor in a recent issue of Physical Review Letters.

The biggest piece of support for RNA molecules as pre-life forms is that RNA can act as both genes (to store information) and enzymes (to catalyze chemical reactions). Like DNA, RNA is made up of a long chain of

nucleotides. However, scientists do not know how a self-replicating RNA system could have arisen from a pool of random polynucleotides.

To address this question, Obermayer, et al., have turned to RNA replicators. As described in previous research, RNA replicators can transmit information from one molecule to another so that the information survives even when the original carrier molecules have become degraded. Here, the researchers have investigated how RNA replicators may have arisen from simpler RNA reactors billions of years ago.

"We show that a combination of simple physico-chemical mechanisms can greatly facilitate the spontaneous emergence of a prebiotic evolutionary system, such as envisaged by the RNA world," Gerland told PhysOrg.com.



In the RNA reactor, nucleotides accumulate in a narrow pore due to a temperature gradient. Due to bond formation and hybridization of RNA strands, weak information transmission can occur: information can be conserved beyond the lifetime of a single molecule. **Image credit: Obermayer, et al. ©2011 American Physical Society**

Using computer simulations, the scientists analyzed a scenario in which a hydrothermal RNA reactor emerges with the ability to perform intermolecular information transmission. The scene begins inside porous rocks on the sea floor, where strong temperature gradients produce thermal convection, and the convective flow transports molecules inside the narrow pores. Due to temperature variations, nucleotides in the pores accumulate in a small region and randomly form bonds with one another. Through folding and hybridization, the polynucleotides can form longer sequences, eventually resulting in RNA strands.

One of the key factors that allows the formation of RNA strands is the preferential cleavage (splitting) of bonds at unpaired bases. This effect creates a selection pressure for base pairing, and leads to an increase in the complexity and lifetime of RNA structures. One such structure that could emerge as a result is a primitive ribozyme- or "RNA enzyme" - which can catalyze chemical reactions as a component of a true RNA replicator.

Most importantly, the computer simulations showed that the RNA reactor can perform weak replication based on information transmission by hybridization of the RNA strands. As the researchers explained, evidence of information transmission appears as an unexpected increase in the lifetime of certain sequences.

"Hybridization simultaneously protects a sequence motif and its complement from degradation," Gerland explained. "Thereby, it extends not only the lifetime of the sequence motif, but also the lifetime of its complement, which in turn can protect other copies of the sequence motif after dissociation. This constitutes a form of information transmission between molecules, since it can conserve the information in the sequence motif beyond the lifetime of a single molecule."

Overall, the computer simulations showed that the prebiotic RNA reactor could serve as a stepping stone toward the emergence of a true RNA replicator. Acting as a filter to keep potentially useful sequences of nucleotides, the RNA reactor could lead to complex sequences, such as ribozymes. Once ribozymes emerge from an RNA reactor, they could establish an efficient self-replicating system in the form of an RNA replicator. In the future, the researchers hope that they might be able to experimentally demonstrate such a process.

"The experimental investigation of this scenario is indeed a very exciting direction to explore," Gerland said. "We believe it is possible to realize essential aspects of the scenario in the lab, on a small scale. We are working towards that end."

More information: Benedikt Obermayer, et al. "Emergence of Information Transmission in a Prebiotic RNA Reactor." Physical Review Letters 107, 018101 (2011) DOI: 10.1103/PhysRevLett.107.018101

http://www.eurekalert.org/pub_releases/2011-07/ip-npr071111.php

Natural pain relief from poisonous shrub

An extract of the poisonous shrub Jatropha curcas acts as a strong painkiller and may have a mode of action different from conventional analgesics, such as morphine and other pharmaceuticals.

Omeh Yusuf and Ezeja Maxwell of the Micheal Okpara University of Agriculture in Umudike, Nigeria, explain how J. curcas, also known as the "physic nut" is a perennial shrub that grows to 5 meters in height and belongs to the Euphobiaceace family. It is native to Central America but grows widely in other tropical and subtropical countries of Africa and Asia. The plant's fruit is combined with the stem bark of Cochlospermum planchonii in Nigerian medicine for treating diabetes mellitus and is also used traditionally as a painkiller. Other medicinal activities have been reported. The plant's seeds have been used for making soap, candles, detergents, lubricants and dyes and the seed oil is used in biodiesel. Details of tests are reported in the current issue of the International Journal of Biomedical Engineering and Technology.

The researchers extracted what they believed to be the physiologically active components of the leaves of J. curcas using methanol as solvent. They compared the effects of this extract at 100, 200 and 400 milligrams per kilogram of body mass, against 400 mg/kg of acetylsalicylic acid (aspirin) in standard laboratory animal tests for assessing the strength of painkillers.

They found that 100 mg/kg was an inadequate dose, however, 200 and 400 mg/kg doses produced analgesia comparable to aspirin, affirming the use of the plant for pain relief in traditional medicine. The team suspect that the extract may be acting through both peripheral and central pain mechanisms. Yusuf and Maxwell are now carrying out more work on isolating and characterizing the active ingredient in the extract and in determining the precise mode of action.

The search for novel analgesic drugs that have a different side-effect profile and lack the tolerance and addiction problems associated with morphine and other opiates is an important avenue of research in drug discovery science. Very few leads from traditional and herbal medicine are successful in generating a new product, but it should be remembered that aspirin and morphine themselves were both originally derived from natural sources.

"The evaluation of the analgesic activity of the methanolic leaf extract of Jatropha curcas (Linn) in experimental animals" in Int. J. Biomedical Engineering and Technology, 2011, 6, 200-207

http://medicalxpress.com/news/2011-07-regional-cool-cardiac-patients-outcomes.html

Regional system to cool cardiac arrest patients improves outcomes

A broad, regional system to lower the temperature of resuscitated cardiac arrest patients at a centrally-located hospital improved outcomes, according to a study in Circulation: Journal of the American Heart Association.

Cooling treatment, or therapeutic hypothermia, is effective yet underused, researchers said.

A network of first responders, EMS departments and more than 30 independent hospitals within 200 miles of Minneapolis, Minn., and Abbott Northwestern Hospital collaborated to implement the protocol.

"We've shown that a fully integrated system of care, from EMS through hospital discharge, can provide this essential therapy to victims of out-of-hospital cardiac arrest across a broad geographic region," said Michael Mooney, M.D., the study's lead author and director of the therapeutic hypothermia program at Minneapolis Heart Institute, where the protocol was developed.

Researchers tracked 140 patients who suffered out-of-hospital cardiac arrest between February 2006 and August 2009. Although their heartbeat and circulation were restored within an hour of collapse, they remained unresponsive. Ice packs were used to begin the cooling process, which started during initial EMS transport to the hospital and in the emergency departments of the network hospitals. One hundred forty patients were admitted to Abbott Northwestern Hospitals for therapeutic hypothermia and re-warming — 107 of those were transferred from other hospitals. Over three to four hours, the patients' core body temperature was lowered to about 92 degrees Fahrenheit and maintained at that temperature for about 24 hours. Over the next eight hours, physicians gradually re-warmed them to a normal temperature.

Researchers found that:

* Among the 56 percent of patients who survived to hospital discharge, 92 percent had positive neurological scores, indicating no severe disability. Prior to the protocol, about 77 percent of similar patients had positive neurologic scores.

* The risk of death rose 20 percent for each hour of delay between the return of spontaneous circulation and cooling.

* Survival rates were comparable between patients who were transferred for care within the network and those who were not.

"What our data show is if you have a cardiac arrest 200 miles away or on our doorstep, the quality of the outcomes is identical," Mooney said.

About 300,000 out-of-hospital cardiac arrests occur in the United States each year and most are fatal, according to the American Heart Association. If a cardiac arrest patient survives the initial loss of oxygen from their arrest, they then face the destruction that unfolds after their blood flow is rapidly restored, which is devastating and often fatal. Therapeutic hypothermia blunts the damage that can occur in the 16-hour window after bloodflow is restored.

The American Heart Association and other experts recommend therapeutic hypothermia, but U.S. cardiologists have been slow to use it. The efficiencies of the area's existing network, transfer agreements and working relationships between the EMS departments, network hospitals and the central hospital helped Mooney and his colleagues implement the protocol.

About half of all patients received therapeutic hypothermia while also being treated for a severe form of heart attack (ST-elevation myocardial infarction) in the catheterization lab, said Barbara Unger, R.N., co-author of the study and director of cardiovascular emergency program development for the Minneapolis Heart Institute.

The average age of patients in the study was 62 and 77 percent were men. Older patients fared slightly worse neurologically, the study found. Prov*ided by American Heart Association*

http://www.nytimes.com/2011/07/12/health/research/12childbirth.html?partner=rss&emc=rss

Vital Signs

Childbirth: Wait to Restart the Pill, C.D.C. Says

By RONI CARYN RABIN

Women who have just given birth should wait at least three weeks before they start using birth control pills because of the risk of serious, potentially fatal blood clots, public health officials announced last week.

Women who deliver by Caesarean section or have other risk factors for blood clots - like obesity or a history of previous blood clots - should wait at least six weeks before using these medications, they said. The new recommendations, by the Centers for Disease Control and Prevention, are more restrictive than guidelines issued last year and are similar to recommendations made in 2010 by the World Health Organization.

Women are far more likely to develop a blood clot in the weeks after delivery than nonpregnant women of reproductive age who have not just had a baby, several studies have shown. The risk declines rapidly after 21 days but does not return to normal until 42 days after delivery.

Birth control pills that include both estrogen and progestin also increase the risk of blood clots in the deep veins (venous thromboembolism). Women who are breast-feeding may want to avoid hormonal contraceptives because they can interfere with lactation, the C.D.C. said.

The guidelines were published in the C.D.C.'s Morbidity and Mortality Weekly Report on Friday.

http://www.nytimes.com/2011/07/12/health/12mosquito.html?partner=rss&emc=rss

Human Swallows Pill. Mosquito Bites Human. Mosquito Dies.

By DONALD G. McNEIL Jr.

Scientists have proposed an intriguing new way to fight malaria: turning people into human time bombs for mosquitoes.

A cheap deworming pill used in Africa for 25 years against river blindness was recently shown to have a power that scientists had long suspected but never before demonstrated in the field: When mosquitoes bite people who have recently swallowed the drug - called ivermectin or Mectizan - they die.

Other scientists caution that while the mosquito-poisoning trick is pretty nifty, it is not very practical: For it to work effectively, nearly everyone in a mosquito-infested area must take the pills simultaneously.

Getting thousands of villagers to do that even in annual deworming campaigns is a logistical nightmare, scientists said. The mosquito-killing effect appears to fade out within a month, so it would need to be repeated monthly. Also, in rare cases, the otherwise safe drug can be lethal.

The new study, published last week by The American Journal of Tropical Medicine and Hygiene, was carried out by scientists from Senegal and Colorado State University. They vacuumed mosquitoes from the walls of huts in three villages whose inhabitants had recently been given ivermectin and three whose had not, and tested to see how many mosquitoes contained malaria parasites. The ivermectin villages had almost 80 percent fewer.

The drug was shortening the mosquitoes' lives, explained the lead author, Brian D. Foy, a Colorado State mosquito expert. Only older insects transmit malaria, since they must get it from humans first.

Dr. Peter Hotez, president of the American Society of Tropical Medicine and Hygiene, was enthusiastic about the study, saying it showed that deworming drugs "could have a lot of collateral effects."

Dr. Lee Hall of the National Institutes of Health, which helped finance the study, was more cautious, saying a clinical trial might be warranted once more is known about how long ivermectin kills.

But a worm expert from the Carter Center in Atlanta was very skeptical.

At present, millions of free doses are given out to fight onchocerciasis, or river blindness, which is caused by tiny worms migrating into the eye. "We hand it out once a year," said the parasitologist, Dr. Frank O. Richards Jr. "I'm pushing for twice a year, and people want to kill me. It's very difficult to imagine a once-a-month program anywhere." It might be useful, he suggested, in areas with brief, intense malaria seasons.

Also, when people with lots of worms are treated, they suffer fever and intense itching as the worms die. Though that might be bearable once a year, it discourages people from seeking treatment more frequently. And ivermectin is dangerous for a few people — those infested with large numbers of a relatively rare West African worm, the loa loa. These worms circulate in the blood and lungs and may jam capillaries when they die, potentially causing coma or death. Detecting them means drawing blood and viewing it under a microscope.

"It's very difficult to say, 'Let's treat a million people' - and then have to test each one for loa loa," Dr. Richards said.

http://news.discovery.com/animals/dinosaur-last-survivor-extinction-triceratops-110712.htm

Triceratops Was Last Dinosaur Standing

The 65 million-year-old find suggests a meteor may have wiped out the dinosaurs in a sudden catastrophic event.

By Jennifer Viegas | Tue Jul 12, 2011 07:00 PM ET

A Triceratops may have been the last dinosaur standing, according to a new study that determined a fossil from Montana's Hell Creek Formation is "the youngest dinosaur known to science." The Triceratops, described in the latest Royal Society Biology Letters, dates to 65 million years ago, the critical period of time associated with the Cretaceous-Tertiary (K-T) extinction event that wiped out all non-avian dinosaurs and many other animals and plants. Since this rhinoceros-looking, three-horned dinosaur lived so close to the mass extinction moment, it could negate an earlier theory that dinosaurs gradually died out before 65 million years ago.

"Our paper suggests that dinosaurs did not go extinct prior to the impact," lead author Tyler Lyson told Discovery News. "The fact that this dinosaur is so close to the K-T boundary lends support to the idea that they went extinct as a result of a meteorite impact." Lyson, a researcher in Yale University's Department of Geology and Geophysics, and his team discovered the remains of the Triceratops, including its over 1.5-foot-long horn, just 5 inches below the pollen-calibrated K-T boundary at Camel Butte, a hill at the Hell Creek Formation in southeastern Montana.

By studying the region's geological layers, the scientists can see how dinosaurs suddenly disappeared after the catastrophic event, which Lyson and many other experts believe was a meteorite strike that directly hit Earth at Mexico's Yucatan Peninsula. Lyson said that "we don't fully understand the kill mechanism," but other researchers "have a proposed a nuclear winter, while others have proposed a thermal pulse." The prior theory that dinosaurs gradually died out before 65 million years ago was often based on what is known as the "3-meter gap," which referred to an apparent geological zone devoid of dinosaur fossils before the K-T event.

The Hell Creek Triceratops, however, was not only found within that 3-meter region, but it also exists at the upper reaches of it, proving that at least one dinosaur and presumably more were still alive when the meteorite blasted into Chicxulub, Mexico.

Co-author Stephen Chester of Yale's Department of Anthropology told Discovery News that the Camel Butte site is important both because it has "the most recent dinosaur specimen" and "because we are finding a great diversity of small mammals that are first documented directly after the extinction event." Chester continued, "Although the K-T mass extinction event is mainly known for the disappearance of the non-avian dinosaurs, it is also an extremely important event in mammalian evolution because once the dinosaurs vanished, mammals underwent a large adaptive radiation and began occupying diverse ecological niches in the Paleocene."

These mammals included condylarths, which were hoofed animals proposed to be ancestral to some modern orders of hoofed mammals. They also included multituberculates, which Chester described as being "extinct rodent-like animals with a very specialized dentition." It remains unclear why certain mammals, turtles and other animals survived the K-T extinction event, but Lyson explained that species with generalist, rather than specialized, diets tended to fare better, as did smaller animals and water dwellers.

Kirk Johnson is vice president of Research & Collections and chief curator at the Denver Museum of Nature & Science. Johnson told Discovery News that he agrees the Triceratops is indeed "the last known non-avian dinosaur of the Cretaceous." He said, "The 3M Gap is a weak concept to begin with," and that his own work on plants and insects supports the idea that the meteor impact was the "direct and immediate cause of habitat destruction and extinction of more than 50 percent of North American plant and insect species."

Peter Sheehan, curatorial chair of the Milwaukee Public Museum's Department of Geology, also agrees with the new findings. He and all of the other researchers, however, suspect that more recent dinosaurs even closer to the K-T boundary will be found in the future.

For now, however, the 65-million-year-old Triceratops is the world's last known surviving dinosaur.

http://www.eurekalert.org/pub_releases/2011-07/ru-mu071311.php

Molecules 'light up' Alzheimer's roots

Rice University lab's light-switching complex attaches itself to amyloid proteins

A breakthrough in sensing at Rice University could make finding signs of Alzheimer's disease nearly as simple as switching on a light. The technique reported in the Journal of the American Chemical Society should help researchers design better medications to treat the devastating disease.

The lab of Rice bioengineer Angel Martí is testing metallic molecules that naturally attach themselves to a collection of beta amyloid proteins called fibrils, which form plaques in the brains of Alzheimer's sufferers.

When the molecules, complexes of dipyridophenazine ruthenium, latch onto amyloid fibrils, their photoluminescence increases 50-fold.

The large increase in fluorescence may be an alternative to molecules currently used to study amyloid fibrils, which researchers believe form when misfolded proteins begin to aggregate. Researchers use changes in fluorescence to characterize the protein transition from disordered monomers to aggregated structures.

Nathan Cook, a former Houston high school teacher and now a Rice graduate student and lead author of the new paper, began studying beta amyloids when he joined Martí's lab after taking a Nanotechnology for Teachers course taught by Rice Dean of Undergraduates and Professor of Chemistry John Hutchinson. Cook's goal was to find a way to dissolve amyloid fibrils in Alzheimer's patients.

But the Colorado native's research led him down a different path when he realized the ruthenium complexes, the subject of much study in Martí's group, had a distinctive ability to luminesce when combined in a solution with amyloid fibrils.

Such fibrils are simple to make in the lab, he said. Molecules of beta amyloid naturally aggregate in a solution, as they appear to do in the brain. Ruthenium-based molecules added to the amyloid monomers do not fluoresce, Cook said. But once the amyloids begin to aggregate into fibrils that resemble "microscopic strands of spaghetti," hydrophobic parts of the metal complex are naturally drawn to them. "The microenvironment around the aggregated peptide changes and flips the switch" that allows the metallic complexes to light up when excited by a spectroscope, he said.

Thioflavin T (ThT) dyes are the standard sensors for detecting amyloid fibrils and work much the same way, Marti said. But ThT has a disadvantage because it fluoresces when excited at 440 nanometers and emits light at 480 nanometers -- a 40-nanometer window.

That gap between excitation and emission wavelengths is known as the Stokes shift. "In the case of our metal complexes, the Stokes is 180 nanometers," said Martí, an assistant professor of chemistry and bioengineering. "We excite at 440 and detect in almost the near-infrared range, at 620 nanometers.

"That's an advantage when we want to screen drugs to retard the growth of amyloid fibrils," he said. "Some of these drugs are also fluorescent and can obscure the fluorescence of ThT, making assays unreliable."

Cook also exploited the metallic's long-lived fluorescence by "time gating" spectroscopic assays. "We specifically took the values only from 300 to 700 nanoseconds after excitation," he said. "At that point, all of the fluorescent media have pretty much disappeared, except for ours. The exciting part of this experiment is that traditional probes primarily measure fluorescence in two dimensions: intensity and wavelength. We have demonstrated that we can add a third dimension -- time -- to enhance the resolution of a fluorescent assay."

The researchers said their complexes could be fitting partners in a new technique called fluorescence lifetime imaging microscopy, which discriminates microenvironments based on the length of a particle's fluorescence rather than its wavelength.

Cook's goal remains the same: to treat Alzheimer's -- and possibly such other diseases as Parkinson's -- through the technique. He sees a path forward that may combine the ruthenium complex's ability to target fibrils and other molecules' potential to dissolve them in the brain.

"That's something we are actively trying to target," Martí said.

Co-authors of the paper are recent Rice graduate Veronica Torres and Disha Jain, a former postdoctoral researcher in Martí's lab. The Welch Foundation supported the research. Read the abstract at http://pubs.acs.org/doi/abs/10.1021/ja204656r

http://www.eurekalert.org/pub_releases/2011-07/uops-pwf071311.php

Pitt, Wake Forest team finds why stored transfusion blood may become less safe with age

PITTSBURGH ***– Transfused blood may need to be stored in a different way to prevent the breakdown of red blood cells that can lead to complications including infection, organ failure and death, say researchers at the University of Pittsburgh School of Medicine and Wake Forest University.***

This week in the early online version of Circulation, the team reports the latest findings from its ongoing exploration of the interaction between red blood cell breakdown products and nitric oxide (NO), revealing new biological mechanisms that can reduce blood flow and possibly damage vital tissues after administration of blood that has been stored for longer than 39 days.

In recent years, doctors have noted that transfusion of either many units of blood or of blood stored a long time may be associated with a greater frequency of complications, such as increased infection risk, kidney, lung or multi-organ failure and death, particularly among medically vulnerable patients, explained senior investigator Mark T. Gladwin, M.D., chief, Division of Pulmonary, Allergy and Critical Care Medicine, Pitt School of Medicine, and director of Pitt's Vascular Medicine Institute.

"When blood sits for a while, some of the cells break down and release their contents, which include molecules of hemoglobin and red blood cell microparticles," he said. "These accumulate in the stored bag of blood and are transfused into the patient with the blood. In the bloodstream, the hemoglobin and microparticles bind to and destroy NO, a very important molecule that is used by the body to keep blood vessels dilated for normal blood flow."

The scavenging of NO causes blood vessel constriction that can prevent tissues and organs from getting adequate oxygen and activate the platelets and the coagulation system, as well as cause inflammation, Dr. Gladwin said.

From their experiments, he and his Wake Forest collaborators found that human blood stored under standard conditions accumulated "free" hemoglobin that was no longer contained in a cell and microparticles of damaged cells. Those breakdown products reacted with NO about 1,000 times more quickly than did intact red blood cells. Also, transfusion of even very low concentrations of hemoglobin caused blood vessel constriction and hypertension in a rat model.

"Avoiding the storage lesion, as it is referred to in our field, could require a new approach to how donor blood is stored prior to transfusion," said senior author Daniel B. Kim-Shapiro, Ph.D., professor of physics and director of the Translational Science Center at Wake Forest.

"Transfusion of stored blood is one of the most common medical therapies," he said. "By understanding the mechanism of the storage lesion, we can design methods to make blood transfusion safer. For example, perhaps we can restore nitric oxide activity that is lost upon transfusion, use preservation solutions that better limit the degradation of blood cells, or develop agents that scavenge free hemoglobin."

Other research projects are underway to find approaches to correct the problem, and to assess the safety of blood for transfusion that has been stored for longer than 14 days. Currently, federal guidelines allow transfusion of blood that has been stored for up to 42 days.

The team includes lead authors Chenell Donadee, M.D., Nicholas J.H. Raat, Ph.D., Albert B. Donnenberg, Ph.D., and Darrel Triulzi, M.D., all of Pitt; and Chen Liu, Hannah Reynolds, and Ivan Azarov, Ph.D., all of Wake Forest.

The study was funded by the National Institutes of Health, the Institute for Transfusion Medicine, and the Hemophilia Center of Western Pennsylvania.

http://www.newscientist.com/article/dn20686-superbug-gonorrhoea-found-in-japan.html

Superbug gonorrhoea found in Japan

*** 14:51 13 July 2011 by Andy Coghlan**

An untreatable strain of the sexually transmitted disease gonorrhoea, resistant to all existing antibiotics, has been identified in Japan.

The news follows warnings last week from the US Centers for Disease Control that it is only a matter of time before invincible strains of Neisseria gonorrhoea emerge in the US.

The Japanese superbug, called H041, was isolated by Magnus Unemo at the Örebro University Hospital in Sweden, and reported this week at the International Society for Sexually Transmitted Disease Research meeting in Quebec, Canada. Unemo, who found the bug in strains from Kyoto, says that it could go global in 10 to 20 years.

The CDC reports that some gonorrhoea strains in the US can now only be killed with one class of antibiotics – the cephalosporins. However, the Japanese superbug may yet meet its nemesis. David Livermore, director of antibiotic resistance monitoring at the UK's Health Protection Agency says that two lesser-known antibiotics, ertapenem and spectinomycin, are the most likely to have activity against it.

But Livermore says the emergence of the resistant strain is disturbing. "It's the first with high-level resistance, so while we've been seeing erosion for several years, this is the breach of the dam." The discovery adds weight to advice for people with new or casual sexual partners to wear condoms, Livermore says.

http://www.scientificamerican.com/article.cfm?id=first-humans-who-left-africa

First Humans Who Left Africa Continued to Mate with Africans

The first humans to leave Africa continued to interbreed with Africans for tens of thousands of years.

By Ewen Callaway pf Nature magazine

Stored inside Craig Venter 's genome are clues to the history of humankind, including global migrations and population crashes. Researchers have mined the genomics pioneer's publicly available DNA sequence, and those of 6 others, to reveal major milestones in human history.

"You can take a single person's genome and learn an entire population's history from it," says David Reich, a geneticist at Harvard Medical School in Boston, Massachusetts, who was not involved in the study. "This is one of the dreams we've had as a community."

The analysis, published today in Nature, suggests that descendants of the first humans to leave Africa dwindled to little more than 1,000 reproductively active individuals before rebounding. The study also suggests that, contrary to assumptions made from archaeological evidence, these early humans continued to breed with sub-Saharan Africans until as recently as 20,000 years ago.

Maternal ties

Geneticists eager to plumb human history have traditionally compared DNA sequences from numerous people around the world to determine how different populations relate to one another and when they might have gone their separate ways. For instance, studies of DNA from maternally inherited cell structures called mitochondria established that all humans can trace their maternal lineage back to one woman -- a mitochondrial Eve -- who lived in Africa around 200,000 years ago.

But, just as mitochondria can lead us back to a single woman, parts of a person's genome inherited from both their mother and father can also be followed back in time, with individual genes traced back to points before any mutations had developed, when just one version -- a common ancestor -- of that gene existed. Because of the way a person's maternal and paternal chromosomes shuffle together to create diversity in their sperm or egg cells, some parts of a person's genome inevitably share common ancestors more recently than other parts.

"Each little piece of the genome has its own unique bit of history and goes to a unique ancestor as you go further and further back," explains John Novembre, a population geneticist at the University of California, Los Angeles , who was not involved in the study. "As you look at different parts of the genome, you get access to different parts of history."

On the basis of this principle, Richard Durbin, a genome scientist at the Wellcome Trust Sanger Institute near Cambridge, UK, and his then post-doc Heng Li determined a way to calculate, from the ages of different segments of a single person's genome, changes in the population size of their ancestors.

The genomes of Venter and two others of European ancestry, two Asian men and two West African men all tell the same story up until about 100,000 years ago, when their populations began to split and then plummet in size, probably reflecting the first human migrations out of Africa.

The ancestors of Asians and Europeans dwindled by a factor of ten to roughly 1,200 reproductively active people between 20,000 and 40,000 years ago, Durbin and Li calculate. African populations also crashed, but by nowhere near the same extent, dropping to around 5,700 breeding individuals. Other studies have recorded population crashes at around the same time, Reich says.

In a different analysis, Durbin and Li compared an X chromosome from an African with one from a non-African to determine when their ancestors stopped interbreeding after the first humans left Africa and colonized other parts of the world. Human remains and artefacts unearthed in Europe, Asia and Australia seem to suggest humans rapidly colonized these places by about 40,000 years ago, diminishing the opportunities to interbreed with Africans.

However, Durbin and Li suggest that these groups continued to interbreed until as recently as 20,000 years ago. One possible explanation, Durbin says, is that after the first humans left Africa some 60,000 years ago, successive waves of Africans followed suit, interbreeding with the ancestors of the earlier migrants.

Mix and match

Chris Stringer , a palaeoanthropologist at the Natural History Museum in London, says that human populations outside Africa were probably small and widely dispersed 20,000-50,000 years ago, so regular interbreeding with Africans seems unlikely. "There could have been surges of gene flow at particular times, driven by innovations or environmental change, but it would be surprising if these continued right through that period," he says.

Mining individual genomes can't reveal every chapter of human history, notes Reich, who now works with Li at the Broad Institute of Harvard and MIT in Cambridge, Massachusetts. The approach reveals little about upheavals of the last 20,000 years, such as the peopling of the Americas, because few chunks of the genome are young enough. Similarly, Durbin and Li's method can't deduce the history of human ancestors who existed before about 2 million years ago because few regions of the genome are much older.

Despite these limitations, Reich plans to lean heavily on the new approach, not least for work on ancient genomes belonging to Neanderthals and a mysterious sister population, known as Denisovans, discovered through DNA recovered from a 30,000-50,000-year-old finger bone found in a Siberian cave4. Reich and his colleagues have been unable to determine when Neanderthals and Denisovans stopped breeding with one another, and the new approach has the potential to answer that question.

http://www.bbc.co.uk/news/uk-scotland-glasgow-west-14138301

New technique could see end of plaster casts

By Eleanor Bradford BBC Scotland Health Correspondent

A Scottish surgeon has come up with a surgical technique which could spell the end of the plaster cast for certain kinds of injuries.

The technique uses an internal support which is inserted via keyhole surgery.

Plaster casts or "stookies", as they are known in Scotland, are used to keep injured limbs immobile. But Professor Gordon Mackay wanted to find a way of avoiding the muscle-wasting and inconvenience of plaster casts, boots and slings.

The professor, from the Ross Hall hospital in Glasgow, said: "I think anyone who's had the experience of trying to put a knitting needle down the cast to get to an itch will realise that a stookie is extremely unpleasant.

"Also, when it comes off, the limb tends to be festering within and your muscles have wasted to nothing."

Ligament damage

Prof Mackay uses keyhole surgery to insert a tiny piece of tape which acts as a brace over injured ligaments.

The brace allows movement but supports the ligaments while they heal. It means patients do not need to have their injured joint immobilised and recovery times are much quicker.

The technique is particularly attracting the interest of sportspeople and athletes, who cannot afford to spend weeks recovering from ligament damage.

One of Professor Mackay's patients is Olympic figure skater Sinead Kerr, who was injured when her skating partner and brother John landed on her. "I've not had any pain since the surgery and I'm taking it step by step but it's gradually getting back to normal," she said. "I think it really helped that I didn't have anything too rigid on my arm locking me in. "I had something that allowed me to do that movement."

More comfortable

Prof Mackay has carried out the procedure on about 20 patients in the UK and is now collaborating with the famous Steadman Clinic in the US, which has treated many injured sport stars.

He said: "If you can move much more quickly then you don't get all the secondary problems and it's much more comfortable for the patient. "They can start the rehabilitation immediately.

"The problem we've had before is that if the joint is unstable it's uncomfortable to move and if you move it too quickly then the tissues stretch and fail. "Here we have an internal brace which prevents the tissues from stretching but still allows you to mobilise the joint with some confidence."

However the technique is not yet available on the NHS so most people who tear ligaments can expect to continue to have to reach for the knitting needle.

http://www.physorg.com/news/2011-07-material-voice.html

New material could offer hope to those with no voice

In 1997, the actress and singer Julie Andrews lost her singing voice following surgery to remove noncancerous lesions from her vocal cords.

She came to Steven Zeitels, a professor of laryngeal surgery at Harvard Medical School, for help.

Zeitels was already starting to develop a new type of material that could be implanted into scarred vocal cords to restore their normal function. In 2002, he enlisted the help of MIT's Robert Langer, the David H. Koch Institute Professor in the Department of Chemical Engineering, an expert in developing polymers for biomedical applications.

The team led by Langer and Zeitels has now developed a polymer gel that they hope to start testing in a small clinical trial next year. The gel, which mimics key traits of human vocal cords, could help millions of people with voice disorders — not just singers such as Andrews and Steven Tyler, another patient of Zeitels'.

About 6 percent of the U.S. population has some kind of voice disorder, and the majority of those cases involve scarring of the vocal cords, says Sandeep Karajanagi, a former MIT researcher who developed the gel while working as a postdoc in the Langer lab. Many of those are children whose cords are scarred from intubation during surgery, while others are victims of laryngeal cancer.

Other people who could benefit are those with voices strained from overuse, such as teachers. "This would be so valuable to society, because every time a person loses their voice, say, a teacher or a politician, all of their contributions get lost to society, because they can't communicate their ideas," Zeitels says.

'A mechanical problem'

When Langer and his lab joined the effort in 2002, they considered two different approaches: creating a synthetic material that would mimic the properties of vocal cords, or engineering artificial vocal-cord tissue. Both approaches have potential, Langer says, but the team decided to pursue a synthetic material because it

would likely take less time to reach patients. “Making a totally natural vocal cord is a more long-term project,” he says.

Some doctors treat vocal-fold scars with materials normally used in dermatology or plastic surgery, in hopes of softening the vocal cords, but those don’t work for everyone, and the effects don’t last long, says Nathan Welham, assistant professor of otolaryngology at the University of Wisconsin School of Medicine.

“Scarred vocal cords are really hard to fix,” says Welham, who is not involved in this project. “People have tried this and that, but there’s really no commonly used, available approach that treats the inherent problem of scarring in the vocal folds.”

Other researchers have tried developing drugs that would dissolve the scar tissue, but the MIT/Harvard team decided on a different approach.

“What we did differently is we looked at this as a mechanical problem that we need to solve. We said, ‘Let’s not look at the scar itself as a problem, let’s think of how we can improve the voice despite the presence of the scar tissue,’” says Karajanagi, who is now an instructor of surgery at Harvard Medical School and a researcher at the Center for Laryngeal Surgery and Voice Rehabilitation at Massachusetts General Hospital.

The team chose polyethylene glycol (PEG) as its starting material, in part because it is already used in many FDA-approved drugs and medical devices.

By altering the structure and linkage of PEG molecules, the researchers can control the material’s viscoelasticity. In this case, they wanted to make a substance with the same viscoelasticity as human vocal cords. Viscoelasticity is critical to voice production because it allows the vocal cords to vibrate when air is expelled through the lungs.

For use in vocal cords, the researchers created and screened many variations of PEG and selected one with the right viscoelasticity, which they called PEG30. In laboratory tests, they showed that the vibration that results from blowing air on a vocal-fold model of PEG30 is very similar to that seen in human vocal folds. Also, tests showed that PEG30 can restore vibration to stiff, non-vibrating vocal folds such as those seen in human patients suffering from vocal-fold scarring.

Under FDA guidelines, the gel would be classified as an injectable medical device, rather than a drug. The researchers, who have published more than a dozen papers on their voice-restoration efforts, have applied for a patent on the material and are working toward FDA approval. If approved for human use, the gel would likely have to be injected at least once every six months, because it eventually breaks down.

The project is funded by the Institute of Laryngology and Voice Restoration, which consists of patients whose mission is to support and fund research and education in treating and restoring voice. Julie Andrews is the foundation’s honorary chairwoman.

Safety tests

In a study recently published in the Annals of Otology, Rhinology & Laryngology, the researchers tested the biocompatibility of the gel by injecting it into the healthy vocal folds of dogs. After four months, the treated dogs showed no damage to their vocal cords.

“That gives us exciting data that this has a real good chance of working in people without creating damage,” Karajanagi says, adding that clinical trials will be needed to confirm this.

The researchers are now working on developing a manufacturing process that will generate enough of the material, in high quality, for human trials. They hope to run a trial of about 10 patients next year. They are also working on developing methods for injecting the material at the right location to treat human vocal cords.

Such gels could find other medical applications, by varying the chemical properties of the PEG, Langer says. “We think of what we do as ‘designer polymers,’” he says. “We can modify them depending on the problem we’re trying to solve.”

http://www.physorg.com/news/2011-07-lurking-bangladesh-great-earthquake.html

Lurking under Bangladesh: The next great earthquake?

After the recent great quakes that have swept away entire coastlines and cities in Japan, Haiti and Sumatra, scientists are now looking hard at the nation that may suffer the gravest threat of all: Bangladesh.

A new documentary from the Earth Institute follows seismologists as they trace signs of deeply buried active faults, past movements of the earth, and sudden, catastrophic river-course changes.

With more than 160 million people, Bangladesh is the most crowded place on earth, and one of the poorest–and it is growing fast. It sits on the world’s largest river delta, close to sea level, which exposes it to tsunamis and the possibility of rivers jumping their banks in the event of earthquake. And, it is furiously putting up bridges and multistory buildings that increase its vulnerability. Scientists have come to recognize that it sits at the juncture of several active tectonic plate boundaries–including the tail end of the one that caused the 2004

Sumatra tsunami that killed over 200,000 people, 1,300 miles south. Syed Humayun Akhter, a seismologist at the Dhaka University Earth Observatory, warns that an earthquake near the crowded capital could dwarf other modern tragedies.

This year saw the start of a five-year, $5 million project to chart the hazards, funded by the U.S. National Science Foundation's Partnerships for International Research and Education program. Led by seismologists at Columbia University's Lamont-Doherty Earth Observatory in conjunction with Dhaka University, the team includes specialists from Vanderbilt University, the University of Minnesota and Queens College, and researchers in Germany, Italy and India. The scientists have been upgrading a network of seismometers that registers tiny tremors far below. This allows them to better map active faults buried under as much as 12 miles of sand and mud laid down by the mighty rivers that drain the Himalayas. They are also drilling some 250 wells near riverbeds to take sediment samples. These, they hope, will reveal the scope and timing of past earthquakes and river-course shifts that may have wiped out large swaths of countryside–though at times when population and infrastructure were far less dense. The goal is to give Bangladeshi scientists and leaders the tools they need to understand, and minimize, the risks.

"Like the great delta on which Bangladesh is confined, we find ourselves at a strategic confluence between earth science, natural hazard engineering and international relations," says Leonardo Seeber, a Lamont seismologist working on the project. This month, Lamont seismologist Michael Steckler, the project's lead investigator, was in Washington to help launch a new program run jointly by NSF and the U.S. Agency for International Development designed to advance such collaborations with developing countries. "This partnership will help particularly with the application of science, technology and innovation to accelerate global development, with huge benefits for industrialized and developing countries alike," said John P. Holdern, director of the White House Office of Science and Technology Policy, speaking at the event.

http://medicalxpress.com/news/2011-07-procedure-simple-painful-condition.html

Procedure can be simple fix for painful back condition

A minimally invasive spine procedure that takes about as much time as a tonsillectomy is an excellent option for some patients who suffer from a painful lower back condition

A minimally invasive spine procedure that takes about as much time as a tonsillectomy is an excellent option for some patients who suffer from a painful lower back condition, according to Christopher McPherson, MD, an assistant professor of neurosurgery at the University of Cincinnati (UC) College of Medicine and a neurosurgeon with the Mayfield Clinic.

McPherson, who has performed the procedure 30 times during the last three years, praises it for its simplicity and effectiveness. It is used in the treatment of select cases of lumbar spinal stenosis, a narrowing of the boney spinal canal, which can cause crowding of the nerve roots and a variety of symptoms, including pain in the leg or lower back and numbness or tingling in the lower back and legs.

The procedure, which utilizes the X-Stop Spacer, a small titanium implant, can be an alternative to the more traditional laminectomy, a more complicated procedure that involves the removal of a small amount of bone. Both procedures work by enlarging the space between the bones in the back and reducing pressure on the spinal nerves. "The X-Stop is essentially a smaller surgery than the laminectomy," McPherson says. "It's a 15- to 30-minute outpatient operation."

The X-Stop, a device manufactured by Medtronic, is designed to accomplish what people with spinal stenosis often attempt to do for themselves. "People with stenosis lean forward when they walk," McPherson explains. "I can spot them in the grocery store because they're leaning forward on their carts. When they flex forward, they open up the space in the spine for the nerves. People with stenosis are self-treating by flexing forward. The idea behind the X-Stop device is to recreate that flexion inside the body."

The procedure is usually done under general anesthesia, although local anesthesia is an option. McPherson begins by making a small incision in the lower back. He then places the X-Stop between the spinous processes, the thin projections from the back of the spinal bones, in the affected area. The implant opens up space and prevents the patient from extending his or her back and putting pressure on the spinal nerves. Patients go home the same day. McPherson says the procedure is suited to individuals with stenosis who experience pain relief when they lean forward and who are either unable to undergo a more involved surgical procedure or prefer to try a less invasive option.

Unlike the traditional laminectomy, which requires the cutting away of a small amount of bone, the X-Stop does not result in the destruction of any bone. "With a laminectomy, there is a small risk of creating instability, and fusion may be required to correct that instability," McPherson says. "With the X-Stop, there is no risk of instability or the need for subsequent fusion."

Published studies have shown that 70 to 80 percent of patients with lumbar stenosis who undergo the X-Stop procedure experience significant improvement of symptoms. If the procedure does not provide relief, a laminectomy remains an option. The procedure, approved by the U.S. Food and Drug Administration in 2005, is covered by Medicare, and more than 10,000 of the procedures have been performed. Nevertheless, private insurers continue to regard it as experimental, which means that younger patients who wish to have the procedure must pay the expense out of pocket.

McPherson reports no conflicts with Medtronic. Provided by University of Cincinnati

http://www.bbc.co.uk/news/uk-scotland-north-east-orkney-shetland-14154598

Westerners 'programmed for fatty foods and alcohol'

Westerners could be genetically programmed to consume fatty foods and alcohol more than those from the east, researchers have claimed.

Scientists at the University of Aberdeen say a genetic switch - DNA which turns genes on or off within cells - regulates appetite and thirst. The study suggests it is also linked to depression. Dr Alasdair MacKenzie conceded it would not stop those moving to the west adapting to its lifestyle. Obesity levels have risen sharply in many Western countries since the 1970s.

Dr MacKenzie, who lead the study team, told BBC Scotland they found Europeans were more inclined to consume fatty foods and alcohol - but that people from the East could end up with the same problems if adapting to a new culture. Scientists at the university's Kosterlitz Centre said the switch controls the galanin gene.

Dr MacKenzie said: "The switch controls the areas of the brain which allows us to select which foods we would like to eat and if it is turned on too strongly we are more likely to crave fatty foods and alcohol.

"The fact that the weaker switch is found more frequently in Asians compared to Europeans suggests they are less inclined to select such options. "These results give us a glimpse into early European life where brewing and dairy produce were important sources of calories during the winter months. "Thus, a preference for food with a higher fat and alcohol content would have been important for survival. "The negative effects of fat and alcohol we see today would not have mattered so much then as life expectancies were between 30 to 40 years."

'Emotional state'

He explained: "It is possible that during the winter individuals with the weaker switch may not have survived as well in Europe as those with the stronger switch and as a result those in the west have evolved to favour a high fat and alcohol rich diet." Dr MacKenzie added: "Galanin is also produced in an area of the brain called the amygdala where it controls fear and anxiety. "Thus, changing levels of galanin in the amygdala will have an effect on an individual's emotional state. Intriguingly, the switch was also active in the amygdala."

The study is being published in the Journal of Neuropsychopharmocology.

http://www.eurekalert.org/pub_releases/2011-07/uocp-smw071411.php

Size matters: Why do people eat less when they have big forks?

Larger portion sizes usually mean we eat more food, but according to new study in the Journal of Consumer Research, bigger bites lead to eating less—in restaurant settings.

"In this research we examined the influence of small versus large bite-sizes on overall quantity of food consumed," write authors Arul Mishra, Himanshu Mishra, and Tamara M. Masters (all University of Utah, Salt Lake City). The authors conducted a field study in a popular Italian restaurant. They used two sizes of forks to manipulate bite sizes and found that diners who used large forks ate less than those with small forks.

The authors then began to investigate why this finding seems to contradict earlier research on portion sizes. "We observe that diners visit the restaurant with a well-defined goal of satiating their hunger and because of this well-defined goal they are willing to invest effort and resources to satiate their hunger goal," the authors write. Diners can satisfy their hunger by choosing, eating, and paying for their food—all of which involve effort.

"The fork size provided the diners with a means to observe their goal progress," the authors explain. "The physiological feedback of feeling full or the satiation signal comes with a time lag. In its absence diners focus on the visual cue of whether they are making any dent on the food on their plate to assess goal progress."

The authors tested this conclusion by varying the quantities of food. They found that when the initial quantity of food was more (a well-loaded plate) diners with small forks ate significantly more than those with large forks. When customers were served small servings, the fork size did not affect the amount of food. Interestingly, in a lab experiment the authors found that participants with small forks consumed less than those with large forks. The authors believe that the participants did not have the same goals of satiating hunger as the restaurant customers did.

To avoid overeating, the authors suggest consumers learn to better understand hunger cues. "People do not have clear internal cues about the appropriate quantity to consume," the authors write. "They allow external cues, such as fork size, to determine the amount they should consume."

Arul Mishra, Himanshu Mishra, and Tamara M. Masters. "The Influence of Bite-size Quantity on Food Consumed: A Field Study."Journal of Consumer Research: February 2011 (published online June 2, 2011).

http://www.eurekalert.org/pub_releases/2011-07/uocp-rrc071411.php

Restaurant reviews: Can negative information have a positive effect?

If you read a number of positive reviews for a product or restaurant, one negative one might actually boost your regard, according to a new study in the Journal of Consumer Research.

That is true as long as the negative information only creates a minor blemish and if you can't think deeply about it.

"Imagine that you are considering a new restaurant and reading reviews of it online," write authors Danit Ein-Gar (Tel-Aviv University) Baba Shiv, and Zakary L. Tormala (both Stanford Graduate School of Business). "Most of the reviews are very favorable: Great food, pleasant music, relaxed atmosphere. Then you come across a review that mentions that there is no parking nearby, a piece of information that is negative but not quite central to your value proposition for restaurants. How does this small dose of negative information influence the positive impression you have begun to form?"

The authors found that when consumers receive negative information after receiving positive information, especially if that negative information is relatively minor and just "blemishes" the product, it accentuates the positive information—if it's encountered after the positives and if the consumers are somewhat distracted.

In one study, the researchers presented consumers with information about a pair of hiking boots. The boots had many positive attributes (orthopedic soles, waterproof, warranty) but they came in a box that was slightly damaged. In another study, college undergrads were offered a chocolate bar on a hot summer day. The chocolate bar was a favorite and it was chilled, but broken in half.

The authors varied the amount of distraction participants faced. "Under low thought conditions—when participants were distracted or had fewer resources available for thinking about their decisions—we observed more favorable reactions to the products when participants received positive plus minor negative information rather than exclusively positive information," the authors write.

"In situations that encourage careful thinking, presenting exclusively positive information still does seem to be more compelling," the authors write. "But in settings that might make careful thought unlikely—as is true of most online ads—presenting some negative information has advantages."

Danit Ein-Gar, Baba Shiv, and Zakary L. Tormala. "When Blemishing Leads to Blossoming: The Positive Effect of Negative Information." Journal of Consumer Research: February 2012 (published online May 13, 2011).

http://www.eurekalert.org/pub_releases/2011-07/uoc--ucf071111.php

UCSF confirms first adenovirus to jump between monkeys and humans

A novel virus that spread through a California monkey colony in late 2009 also infected a human researcher and a family member, UCSF researchers have found, the first known example of an adenovirus "jumping" from one species to another and remaining contagious after the jump.

In a study by the UCSF Viral Diagnostics and Discovery Center, which identified the new virus at the time of the outbreak, researchers confirmed it was the same virus in the New World titi monkeys and the two humans. They also confirmed that the virus is highly unusual in both populations, suggesting that it may have originated from a third, unidentified species. The direction in which the virus spread, however – from monkeys to humans or vice versa – remains a mystery. Findings appear in the July 14 issue of PLoS Pathogens, a weekly journal of the Public Library of Science, and can be found at http://dx.plos.org/10.1371/journal.ppat.

Adenoviruses naturally infect many animals, including humans, monkeys and rodents, and are known to cause a wide range of clinical illnesses in humans, from cold-like symptoms to diarrhea and pneumonia. Unlike influenza or coronaviruses, adenoviruses had not been known to spread from one species to another.

"Now adenoviruses can be added to the list of pathogens that have the ability to cross species," said Charles Chiu, MD, PhD, an assistant professor of laboratory medicine and infectious diseases at UCSF and director of the viral diagnostics center. "It's been hinted at before, but this study is the first to document these viruses crossing the species barrier in real time."

The virus, which researchers have named titi monkey adenovirus (TMAdV), infected more than a third of the titi monkeys in the California National Primate Research Center (CNPRC) in late 2009. In the monkeys, the virus was devastating, causing an upper respiratory illness that progressed to pneumonia and eventually killed 19 of the 23 monkeys (83 percent) that became sick, including healthy young adult monkeys.

Around the time of the outbreak, a researcher who was taking care of the sick monkeys also developed an upper respiratory infection, with fever, chills and a cough that lasted four weeks, as did two members of the researchers' family who had no contact with the monkey colony. All three recovered fully without medical treatment.

The primate center called Chiu when the illness spread through the colony to help identify the pathogen and prevent its spread to other animals. The UCSF Viral Diagnostics and Discovery Center specializes in using a microarray Virochip technology developed at UCSF to identify viruses affecting humans, animals, insects or plants. Because the researcher's illness was not reported for several months, the virus could no longer be detected directly, so Chiu worked with the California Department of Public Health to conduct antibody testing on the monkeys, the researcher and two of the researcher's family members who also reported having been sick.

Antibodies are a product of the body's immune response to pathogens and generally remain in the bloodstream for several months after infection. As a result, they serve as a marker of whether a person was exposed to a specific virus. Both the monkeys and researcher tested positive for antibodies to the TMAdV virus, as did one of the two family members. No other humans at the center were found to have been infected.

The UCSF team found that the new virus clearly belonged to the adenovirus family, yet was unlike any adenovirus ever reported to infect humans or monkeys, including from large-scale studies by public health agencies such as the U.S. Centers for Disease Control and Prevention. The new virus was so unusual, in fact, that it shares only 56 percent of its DNA to its closest viral relative.

"This is clearly a new species of adenovirus and it's quite different from anything we've seen previously," said Chiu. "Given the unusually high fatality rate of TMAdV in the titi monkeys, they are not likely to be the native host species for this virus. We still don't know what species is the natural host."

Chiu said the lack of previous records of this virus in humans indicates that it is also unlikely to have started with the researcher. In testing other monkeys at the primate center, the team found one healthy rhesus (Old World) monkey with antibodies to TMAdV, which Chiu said could indicate that the virus originated in Old World monkeys, then spread to the New World colony that lacked antibodies against it.

The viral center is conducting further studies in both humans and monkeys in Brazil and Africa to determine whether the virus is common in wild populations of either Old World or New World monkeys, and whether it has crossed species in those settings to humans who live nearby.

Eunice C. Chen, of the UCSF Viral Diagnostics and Discovery Center, was first author on the paper. Co-authors include Shigeo Yagi and David P. Schnurr, of the Viral and Rickettsial Disease Laboratory in the California Department of Public Health, Richmond, Calif.; and Kristi R. Kelly, Sally P. Mendoza, Nicole Maninger, Ann Rosenthal, Abigail Spinner, Karen L. Bales and Nicholas W. Lerche, of the California National Primate Research Center, UC Davis, Davis, Calif. Bales is also with the UC Davis Department of Psychology.

This work was supported by grants from the NIH and an Abbott Viral Discovery Award to Charles Chiu. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript. UCSF has filed a patent application related to the novel adenovirus TMAdV.

http://www.scientificamerican.com/blog/post.cfm?id=alzheimers-risk-linked-to-common-co-2011-07-14

Alzheimer's Risk Linked to Common Complaints, from Poor Eyesight to Denture Trouble

By Katherine Harmon | Jul 14, 2011 09:37 AM | 3

As we age, all sorts of things may start to break down. Joints ache, or vision fails, and or maybe cognitive abilities falter.

The leading known risk for getting Alzheimer's disease or other forms of dementia is simply getting older, followed, some studies suggest, by major illnesses, such as diabetes, heart disease, high blood pressure and stroke. But new research suggests that many of the littler aches, pains or minor disabilities that often pile on with age are linked to increased risk for Alzheimer's and dementia.

The new study compared data from 7,239 Canadian adults 65 or older who were dementia-free. After five and 10 years, those in the study were asked about cognitive clarity and asked to report on 19 different health and wellbeing factors (including hearing, foot problems and how well their dentures fit). After the full decade, of the 4,324 people who were still alive, 416 had Alzheimer's disease, 191 had another sort of dementia and 677 had other cognitive problems (1,023 were of uncertain cognitive ability). The findings were described online July 13 in Neurology.

Each individual health complaint increased the risk of having dementia by an average of about 3 percent. But as issues accumulated, one's risk for cognitive decline grew, too. A healthy older adult had about an 18 percent chance of having dementia after 10 years, whereas those who reported poor health on a dozen of the health and wellbeing measures had, on average, closer to a 40 percent chance.

The findings suggest that Alzheimer's prevention be focused not just on drugs or major health issues, but that "keeping up your general health may help reduce the risk for dementia," Kenneth Rockwood, of the Division of

Geriatric Medicine at Veterans Memorial Lane in Halifax, Canada and a co-author of the new study, said in a prepared statement.

The links held after adjusting for age and other known risk factors. But they will require verification from future studies. The data comes from broader health surveys that were not specifically assembled to measure these risk factors for dementia, and many of those who died during the course of the study likely had dementia. "Much uncertainty remains," cautioned the authors of an essay published in the same issue of Neurology, Jean Francois Dartigues and Catherine Ferat, both of Victor Segalen University Bordeaux in France. But, they note, the findings "suggest a new vision of preventive or curative treatments which, instead of targeting specific etiologic mechanisms, would instead aim at improving general health."

And even if a small fraction of cases could be prevented or limited in severity by improving overall health and lifestyle, it could make a big difference in the burden of Alzheimer's, which is expected to reach some 100 million people worldwide by 2050.

The 19 minor health issues analyzed for the study were overall health, eyesight, hearing, denture fit, arthritis/rheumatism, eye trouble, ear trouble, stomach trouble, kidney trouble, bladder control, bowel control, feet/ankle trouble, stuffy nose/sneezing, bone fractures, chest problems, cough, skin problems, dental problems, other problems. The most common complaint for all surviving individuals after 10 years was arthritis/rheumatism, which was only slightly higher among those with Alzheimer's or dementia. But two of the largest differences between those who were cognitively healthy and those with Alzheimer's after a decade was poor eyesight (3 percent and 9 percent, respectively) and poor hearing (3 percent and 6 percent, respectively).

http://www.bbc.co.uk/news/health-14152095

Gene link to 70% of hard-to-treat breast cancers

By James Gallagher Health reporter, BBC News

A gene has been linked to 70% of hard-to-treat breast cancers which are resistant to hormone therapies, in US research.

The study published in Nature used a new technique which tested hundreds of genes at once, rather than one at a time. Scientists said there was "a lot of potential for significant impact" if drugs could be developed.

Cancer Research UK said it would be interesting to see where the study led.

Hormones can force tumour growth, so drugs which interfere with that process, such tamoxifen and aromatase inhibitors, are used as treatments. Up to a third of breast cancers, however, are not hormone driven, so these drugs do not work and there are fewer treatments available for these patients.

Turn off

The researchers at the Whitehead Institute for Biomedical Research, Massachusetts, used small, disruptive, snippets of genetic material which can turn off genes. They injected cancerous cells with the snippets to investigate which genes were necessary for tumour formation and growth. They found that the gene - PHGDH -was highly active, far more than usual, in 70% of tumours which did not respond to hormone therapies.

Over expression of the gene results in the chemistry of a cancerous cell changing and is involved in the production of an amino acid - serine. The hope is that by identifying the gene which leads to some breast cancers, a drug can be developed which interferes with its activity.

Dr Richard Possemato told the BBC: "There is a lot of potential for a significant impact if a therapy targeting the serine pathway were found to be effective. "However, as we do not treat any patients in our study, or develop any chemical inhibitors of the pathway, it would be very premature to predict the response in the general population." The technique used allowed researchers to analyse large numbers of genes, they said "the technological advance is one of scale".

Cancer Research UK's Henry Scowcroft said: "The more scientists delve into cancer's inner secrets, the more clues to future treatments they discover. "This early work has identified a possible new avenue for future research into a hard-to-treat form of breast cancer, and it will be interesting to see where it leads."

http://medicalxpress.com/news/2011-07-coffee-tea-consumption-mrsa.html

Coffee and tea consumption reduce MRSA risk

While an apple a day may keep the doctor away, new research published in the Annals of Family Medicine say that hot tea or coffee may keep the methicillin-resistant Staphyloccus aureus, or MRSA, bug away, or at least out of your nose.

The study, led by Eric Matheson from the University of South Carolina, looked at 5,500 Americans and their coffee and hot tea consumption in association with the presence of the MRSA bacteria in the nasal cavity.

In general, around one percent of the population in the United States carries the MRSA in their nose or on their skin but does not become sick with MRSA. Laboratory studies have shown that tea extracts that were

inhaled or topically applied showed anti-MRSA activity. This laboratory evidence prompted Matheson to look at how the consumption of tea and coffee might play a role in MRSA nasal carriage.

Out of the 5,500 participants, 1.4 percent was positive for MRSA in their nose. However, when the group was broken down into groups based on tea and coffee consumption, the number lowered. Those that drank either tea or coffee saw a reduction of around 50 percent, while those that consumed both beverages say a reduction of 67 percent.

While the study was unable to show a direct causal relationship between coffee and tea consumption and nasal MRSA, the researchers do believe there is a connection. They are looking at the potential antibacterial properties of glyoxal, methylglyoxal, trigonelline and diacetyl in coffee and tannic acid and catechins in tea.

Debate is still out however as to whether a reduction in a person's MRSA nasal carriage risk by drinking coffee and tea would also reduce a person's risk of falling ill to MRSA. It is also still debated as to whether MRSA carriers are at an increased risk of active infection.

http://www.newscientist.com/article/dn20694-e-colis-genetic-code-has-been-hacked.html

E. coli's genetic code has been hacked

19:00 14 July 2011 by Ferris Jabr

The genetic code common to all life is not set in stone. We can change it at its most fundamental level for our own purposes. Genetic engineers have invented a new way to quickly, precisely and thoroughly rewrite the genome of living bacteria.

The technique could make drug-producing bacteria immune to viruses, prevent laboratory engineered organisms from genetically contaminating wildlife and enable scientists to construct proteins that do not exist in nature.

Farren Isaacs of Yale University led the team that this week proves it is possible to make numerous and very precise changes in the genome of living cells. "In the process we are recoding organisms that could have completely new functionality. I think it's a tour de force, one of the top 10 papers of the year," says Frederick Blattner of the University of Wisconsin-Madison, who was not involved in the study. "Even though the genes are essential, they can be altered." Ultimately, the study paves the way for re-coding the universal genetic code.

Stop sign swap

Isaacs and his colleagues systematically replaced one three-letter sequence in the genome of Escherichia coli with another. Three-letter genetic sequences are known as codons, and they can either code for an amino acid – the building blocks of proteins – or act as stop signals. A cell's internal machinery reads copies of the genome, and as it goes along it links the corresponding amino acids together into protein strings until it reaches a stop codon. The researchers sifted through the E. coli genome and identified all 314 TAG stop codons. They then designed fragments of single-stranded DNA that, with the assistance of viral enzymes, would replace the TAG stop codons with TAA, another stop codon.

Isaacs submerged a billion E. coli cells in pools of water brimming with the bits of DNA and viral enzymes, and zapped the mixture with electricity, opening pores in the bacteria's cell membranes for the DNA to pass through. The process is known as multiplex automated genome engineering, or MAGE.

Pizza party

Isaacs then isolated 32 strains from the mixture, each of which had around 10 TAA codons instead of TAG codons at different points in the genome. The next challenge was to combine these partially rewritten genomes into a single genome with 314 TAA stop codons and no TAG codons. How did they do it? Think promiscuous pizzas.

Imagine the E. coli genome as a pizza cut into 32 slices that together contain all 314 TAG codons, but not on one slice. Isaacs encouraged the bacteria to swap DNA by manipulating the bacterial equivalent of sex - a process called conjugation, in which two bacteria exchange fragments of DNA but do not produce any offspring. By systematically pairing different bacteria, the team gradually moved ever closer to producing one strain with nothing but TAA stop codons. Isaacs calls this process conjugative assembly genome engineering, or CAGE.

Isaacs and his colleagues have so far winnowed the 32 strains down to four, in which nearly all TAG codons are replaced by TAA codons. The emergence of the final strain is imminent. Theoretically, CAGE should take only about five weeks - far faster than any other technique to produce an artificial genome.

The required equipment is much cheaper than for other methods, too. Whereas Craig Venter's synthetic genome cost $40 million, an "evolution machine" to perform MAGE might cost only $90,000.

Rewriting the genome, wholesale

James Collins of Boston University says the paper represents an important advance for synthetic biology. "The team shows it is possible to introduce in a rational way large-scale changes in the genome of an organism.

They have very cleverly swapped one punctuation mark with another punctuation mark, which opens up the possibility of rewriting the genome wholesale."

Even more remarkably, it opens the possibility of rewriting the genetic code.

Theoretically, once a particular codon – say, TAG - has been removed from a genome, the cell's protein-making machinery could be reprogrammed to assign TAG to an amino acid, instead of being a stop signal.

And if the amino acid were not one of the dominant 20 found in nature or a completely new, synthetic amino acid, then the cell could produce entirely novel proteins. "That's the vision," says Blattner, "completely refactoring the genome to where it is quite substantially different from any other life forms."

There are other advantages. Genetically engineered organisms whose genomes are written in a brand new genetic code cannot mix promiscuously with other organisms if they escape into the wild. A new genetic code would also confer immunity on bacterial cells against viruses, which attack by incorporating themselves into the host cell's own DNA. That could help with applications like drug production: the bacteria we engineer to produce drugs like insulin are routinely attacked by viruses.

"The code is totally arbitrary," says Blattner. "We can manipulate the fundamental aspects of life."

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http://www.scientificamerican.com/article.cfm?id=nasa-spacecraft-enters

NASA Spacecraft Enters Orbit Around Asteroid Vesta--A Space First

The probe made history by becoming the first to orbit an object in our solar system's asteroid belt

By Tariq Malik and SPACE.com | Sunday, July 17, 2011 | 2

An unmanned NASA probe made history 117 million miles from Earth on Saturday (July 16) when it arrived at the huge asteroid Vesta, making it the first spacecraft ever to orbit an object in the solar system's asteroid belt.

The Dawn spacecraft entered orbit around Vesta after a four-year chase and will spend about a year studying the huge space rock before moving on to visit another asteroid called Ceres.

Vesta is a huge asteroid about the size of the U.S. state of Arizona, and is also the brightest asteroid in the solar system. It is located in the asteroid belt, a band of rocky objects that encircles the sun between the orbits of Mars and Jupiter.

ASTEROID ORBIT: NASA's Dawn spacecraft snapped this photo of the huge asteroid Vesta on July 9, 2011. It was taken from a distance of about 26,000 miles (41,000 kilometers) away **Image: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA**

"Today, we celebrate an incredible exploration milestone as a spacecraft enters orbit around an object in the main asteroid belt for the first time," NASA chief Charles Bolden said in a statement. "Dawn's study of the asteroid Vesta marks a major scientific accomplishment and also points the way to the future destinations where people will travel in the coming years. President Obama has directed NASA to send astronauts to an asteroid by 2025, and Dawn is gathering crucial data that will inform that mission."

Solar system's biggest asteroids up close

NASA launched the $466 Dawn mission in 2007 to explore the largest asteroids in the asteroid belt. Vesta is 330 miles (530 kilometers) wide, large enough that astronomers consider it to be a protoplanet. Astronomers do not understand why the asteroid is so bright and hope Dawn will answer that and other mysteries of Vesta.

After studying Vesta in unprecedented detail, the Dawn probe is expected fire up its ion propulsion system to leave orbit and head to Ceres — an object so big it is the largest asteroid in the solar system and officially designated a dwarf planet. Ceres is about 590 miles (950 km) wide. Dawn will arrive at this target in 2012, NASA officials said. [7 Strangest Asteroids in the Solar System]

Dawn launched in September 2007 and has covered more than 1.7 billion miles (2.7 billion km) on the voyage to Vesta. Just after Dawn arrived at Vesta, the spacecraft beamed a message to Earth to alert its NASA controllers at the Jet Propulsion Laboratory in Pasadena, Calif., of the milestone. But the exact time of the probe's asteroid arrival is not yet known, NASA officials said. Mission managers initially estimated that the time of arrival would be at about 10 p.m. PDT Friday (July 15; 1 a.m. EDT Saturday).

"The time of Dawn's capture depended on Vesta's mass and gravity, which only has been estimated until now," mission managers said in a statement. "The asteroid's mass determines the strength of its gravitational pull. " The more massive Vesta is, the stronger its gravity will be and it would have pulled Dawn into orbit earlier than expected, they added. If the asteroid is less massive, the gravitational pull would be weaker and Dawn would have taken longer to reach orbit.

Missions to asteroid

But arrival time aside, the Dawn probe is most assuredly blazing a new trail in space, NASA officials said.

While past missions by NASA and other space agencies have sent spacecraft to visit asteroids, none of those targets were in the asteroid belt.

In 2000, NASA's Near-Earth Asteroid Rendezvous Shoemaker (or NEAR Shoemaker) probe went into orbit around the asteroid Eros, ultimately landing on the space rock at the end of its mission.Japan's Hayabusa mission sent a probe to collect samples from the asteroid Itokawa. That mission returned tiny grains of Itokawa to Earth last year.

Dawn's mission was first-approved by NASA in 2001, a year after the NEAR Shoemaker arrival at Eros. But budget issues prompted NASA to cancel the mission in March 2006, which sparked outcry among researchers. NASA reinstated the mission just weeks after its cancellation.

NASA is now planning to launch a new asteroid mission called Osiris-Rex, in spacecraft to a near-Earth asteroid in 2016 and collect samples from the space rock in 2020. That mission is expected to return any samples it collects to Earth in 2023.

http://www.eurekalert.org/pub_releases/2011-07/dbnl-wkt071311.php

What keeps the Earth cooking?

Berkeley Lab scientists join their KamLAND colleagues to measure the radioactive sources of Earth's heat flow

What spreads the sea floors and moves the continents? What melts iron in the outer core and enables the Earth's magnetic field? Heat. Geologists have used temperature measurements from more than 20,000 boreholes around the world to estimate that some 44 terawatts (44 trillion watts) of heat continually flow from Earth's interior into space. Where does it come from?

Radioactive decay of uranium, thorium, and potassium in Earth's crust and mantle is a principal source, and in 2005 scientists in the KamLAND collaboration, based in Japan, first showed that there was a way to measure the contribution directly. The trick was to catch what KamLAND dubbed geoneutrinos – more precisely, geo-antineutrinos – emitted when radioactive isotopes decay. (KamLAND stands for Kamioka Liquid-scintillator Antineutrino Detector.)

"As a detector of geoneutrinos, KamLAND has distinct advantages," says Stuart Freedman of the U.S. Department of Energy's Lawrence Berkeley National Laboratory (Berkeley Lab), which is a major contributor to KamLAND. Freedman, a member of Berkeley Lab's Nuclear Science Division and a professor in the Department of Physics at the University of California at Berkeley, leads U.S. participation. "KamLAND was specifically designed to study antineutrinos. We are able to discriminate them from background noise and detect them with very high sensitivity."

KamLAND scientists have now published new figures for heat energy from radioactive decay in the journal Nature Geoscience. Based on the improved sensitivity of the KamLAND detector, plus several years' worth of additional data, the new estimate is not merely "consistent" with the predictions of accepted geophysical models but is precise enough to aid in refining those models.

One thing that's at least 97-percent certain is that radioactive decay supplies only about half the Earth's heat. Other sources – primordial heat left over from the planet's formation, and possibly others as well – must account for the rest.

Hunting for neutrinos from deep in the Earth

Antineutrinos are produced not only in the decay of uranium, thorium, and potassium isotopes but in a variety of others, including fission products in nuclear power reactors. In fact, reactor-produced antineutrinos were the first neutrinos to be directly detected (neutrinos and antineutrinos are distinguished from each other by the interactions in which they appear).

Because neutrinos interact only by way of the weak force – and gravity, insignificant except on the scale of the cosmos – they stream through the Earth as if it were transparent. This makes them hard to spot, but on the very rare occasions when an antineutrino collides with a proton inside the KamLAND detector – a sphere filled with a thousand metric tons of scintillating mineral oil – it produces an unmistakable double signal.

The first signal comes when the antineutrino converts the proton to a neutron plus a positron (an anti-electron), which quickly annihilates when it hits an ordinary electron – a process called inverse beta decay. The faint flash of light from the ionizing positron and the annihilation process is picked up by the more than 1,800 photomultiplier tubes within the KamLAND vessel. A couple of hundred millionths of a second later the neutron from the decay is captured by a proton in the hydrogen-rich fluid and emits a gamma ray, the second signal. This "delayed coincidence" allows antineutrino interactions to be distinguished from background events such as hits from cosmic rays penetrating the kilometer of rock that overlies the detector.

Says Freedman, "It's like looking for a spy in a crowd of people on the street. You can't pick out one spy, but if there's a second spy following the first one around, the signal is still small but it's easy to spot."

KamLAND was originally designed to detect antineutrinos from more than 50 reactors in Japan, some close and some far away, in order to study the phenomenon of neutrino oscillation. Reactors produce electron neutrinos, but as they travel they oscillate into muon neutrinos and tau neutrinos; the three "flavors" are associated with the electron and its heavier cousins.

Being surrounded by nuclear reactors means KamLAND's background events from reactor antineutrinos must also be accounted for in identifying geoneutrino events. This is done by identifying the nuclear-plant antineutrinos by their characteristic energies and other factors, such as their varying rates of production versus the steady arrival of geoneutrinos. Reactor antineutrinos are calculated and subtracted from the total. What's left are the geoneutrinos.

Tracking the heat

All models of the inner Earth depend on indirect evidence. Leading models of the kind known as bulk silicate Earth (BSE) assume that the mantle and crust contain only lithophiles ("rock-loving" elements) and the core contains only siderophiles (elements that "like to be with iron"). Thus all the heat from radioactive decay comes from the crust and mantle – about eight terawatts from uranium 238 (238U), another eight terawatts from thorium 232 (232Th), and four terawatts from potassium 40 (40K).

KamLAND's double-coincidence detection method is insensitive to the low-energy part of the geoneutrino signal from 238U and 232Th and completely insensitive to 40K antineutrinos. Other kinds of radioactive decay are also missed by the detector, but compared to uranium, thorium, and potassium are negligible contributors to Earth's heat.

Additional factors that have to be taken into account include how the radioactive elements are distributed (whether uniformly or concentrated in a "sunken layer" at the core-mantle boundary), variations due to radioactive elements in the local geology (in KamLAND's case, less than 10 percent of the expected flux), antineutrinos from fission products, and how neutrinos oscillate as they travel through the crust and mantle. Alternate theories were also considered, including the speculative idea that there may be a natural nuclear reactor somewhere deep inside the Earth, where fissile elements have accumulated and initiated a sustained fission reaction.

KamLAND detected 841 candidate antineutrino events between March of 2002 and November of 2009, of which about 730 were reactor events or other background. The rest, about 111, were from radioactive decays of uranium and thorium in the Earth. These results were combined with data from the Borexino experiment at Gran Sasso in Italy to calculate the contribution of uranium and thorium to Earth's heat production. The answer was about 20 terawatts; based on models, another three terawatts were estimated to come from other isotope decays. This is more heat energy than the most popular BSE model suggests, but still far less than Earth's total. Says Freedman, "One thing we can say with near certainty is that radioactive decay alone is not enough to account for Earth's heat energy. Whether the rest is primordial heat or comes from some other source is an unanswered question."

Better models are likely to result when many more geoneutrino detectors are located in different places around the globe, including midocean islands where the crust is thin and local concentrations of radioactivity (not to mention nuclear reactors) are at a minimum. Says Freedman, "This is what's called an inverse problem, where you have a lot of information but also a lot of complicated inputs and variables. Sorting those out to arrive at the best explanation among many requires multiple sources of data."

"Partial radiogenic heat model for Earth revealed by geoneutrino measurements," by the KamLAND Collaboration, Itaru Shimizu of Tohoku University, Sendai, Japan, corresponding author, is published in Nature Geoscience and is available in advanced online publication at http://www.nature.com/ngeo/index.html.

Berkeley Lab and UC Berkeley members of the KamLAND Collaboration include Thomas Banks, Thomas Bloxham, Jason Detwiler, Stuart Freedman, Brian Fujikawa, Ke Han, Richard Kadel, Hitoshi Murayama, Thomas O'Donnell, and Herbert Steiner. Besides Tohoku University, Lawrence Berkeley National Laboratory, and the University of California at Berkeley, member institutions of the KamLAND Collaboration are the Institute for the Physics and Mathematics of the Universe, Tokyo University, Kashiwa (of which Hitoshi Murayama is also the director); the University of Alabama, Tuscaloosa; the California Institute of Technology, Pasadena; Colorado State University, Fort Collins; Drexel University, Philadelphia; the University of Hawaii at Manoa; Kansas State University, Manhattan; Stanford University, Palo Alto, California; the University of Tennessee, Knoxville; Triangle Universities Nuclear Laboratory, Durham, and Duke University, North Carolina Central University, and the University of North Carolina at Chapel Hill; the University of Wisconsin at Madison, and NIKHEF (National Institute for Subatomic Physics), Amsterdam.

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