McGill-UBC project creates mouse grimace scale to help identify pain in humans and animals

A new study by researchers from McGill University and the University of British Columbia shows that mice, like humans, express pain through facial expressions.

McGill Psychology Prof. Jeffrey Mogil, UBC Psychology Prof. Kenneth Craig and their respective teams have discovered that when subjected to moderate pain stimuli, mice showed discomfort through facial expressions in the same way humans do. Their study, published online May 9 in the journal Nature Methods, also details the development of a Mouse Grimace Scale that could inform better treatments for humans and improve conditions for lab animals.

Because pain research relies heavily on rodent models, an accurate measurement of pain is paramount in understanding the most pervasive and important symptom of chronic pain, namely spontaneous pain, says Mogil. "The Mouse Grimace Scale provides a measurement system that will both accelerate the development of new analgesics for humans, but also eliminate unnecessary suffering of laboratory mice in biomedical research," says Mogil. "There are also serious implications for the improvement of veterinary care more generally."

This is the first time researchers have successfully developed a scale to measure spontaneous responses in animals that resemble human responses to those same painful states.

Mogil, graduate student Dale Langford and colleagues in the Pain Genetics Lab at McGill analyzed images of mice before and during moderate pain stimuli – for example, the injection of dilute inflammatory substances, as are commonly used around the world for testing pain sensitivity in rodents. The level of pain studied could be comparable, researchers said, to a headache or the pain associated with an inflamed and swollen finger easily treated by common analgesics like Aspirin or Tylenol.

Mogil then sent the images to Craig's lab at UBC, where facial pain coding experts used them to develop the scale. Craig's team proposed that five facial features be scored: orbital tightening (eye closing), nose and cheek bulges and ear and whisker positions according to the severity of the stimulus. Craig's laboratory had previously established studying facial expression as the standard for assessing pain in human infants and others with verbal communication limitations. This work is an example of successful "bedside-to-bench" translation, where a technique known to be relevant in our species is adapted for use in laboratory experiments.

Continuing experiments in the lab will investigate whether the scale works equally well in other species, whether analgesic drugs given to mice after surgical procedures work well at their commonly prescribed doses, and whether mice can respond to the facial pain cues of other mice.

Medical costs of cancer have nearly doubled over the past 2 decades

A new analysis finds that the costs of treating cancer have nearly doubled over the past two decades and that the shares of these costs that are paid for by private health insurance and Medicaid have increased. The study also reveals that cancer costs have shifted away from inpatient treatments to outpatient care. Published early online in CANCER, a peer-reviewed journal of the American Cancer Society, the information could be used to prioritize future resources for treating and preventing cancer.

Little information is available on how overall cancer costs have changed over time and who now bears the burden of financing the bulk of cancer-related expenses. To study recent trends in the medical costs of cancer and how these costs are paid for, Florence Tangka, Ph.D., a health economist at the Centers for Disease Control and Prevention (CDC) led a team of scientists from CDC, Emory University, and RTI International in analyzing data from the 2001 through 2005 Medical Expenditures Panel Survey and its predecessor, the National Medical Care Expenditure Survey, a one-time survey conducted in 1987. Both surveys are nationally representative of individuals across the United States and capture self-reported data on medical conditions and related expenditures.

The investigators found that in 1987 the total medical cost of cancer (in 2007 dollars) was $24.7 billion. Private insurance financed the largest share of the total (42 percent), followed by Medicare (33 percent). Out-of-pocket payments accounted for 17 percent of the costs, other public sources paid for 7 percent, and Medicaid paid for 1 percent. Between 1987 and the 2001-2005 period, the total medical cost of cancer increased to $48.1 billion due to new cases diagnosed among the aging population as well as an increase in the prevalence of cancer. In 2001-2005, private insurance paid for 50 percent of the costs, and Medicare paid for 34 percent. Out-of-pocket payments accounted for 8 percent of the costs, other public sources paid for 5 percent, and Medicaid paid for 3 percent.

The analysis also revealed that the share of total cancer costs incurred after inpatient hospital admissions fell from 64.4 percent in 1987 to 27.5 percent in 2001-2005. The decrease in cancer-related inpatient costs was accompanied by an increase in cancer-attributable outpatient expenditures.

"The information provided in this study enhances our understanding of the burden of cancer on specific payers and how this burden may change as a result of health reform measures or other changes to health care financing and delivery," said Dr. Tangka. The authors noted that additional research will be needed to determine the impact of these changes on costs and quality of cancer care in the United States.

Article: "Cancer treatment cost in the United States: has the burden shifted over time?" Florence K. Tangka, Justin G. Trogdon, Lisa C. Richardson, David Howard, Susan A. Sabatino, and Eric A. Finkelstein. CANCER; Published Online: May 10, 2010 (DOI:10.1002/cncr.25150).

The Science of a Happy Marriage

By TARA PARKER-POPE

Stuart Bradford

Why do some men and women cheat on their partners while others resist the temptation?

To find the answer, a growing body of research is focusing on the science of commitment. Scientists are studying everything from the biological factors that seem to influence marital stability to a person's psychological response after flirting with a stranger.

Their findings suggest that while some people may be naturally more resistant to temptation, men and women can also train themselves to protect their relationships and raise their feelings of commitment.

Recent studies have raised questions about whether genetic factors may influence commitment and marital stability. Hasse Walum, a biologist at the Karolinska Institute in Sweden, studied 552 sets of twins to learn more about a gene related to the body's regulation of the brain chemical vasopressin, a bonding hormone.

Over all, men who carried a variation in the gene were less likely to be married, and those who had wed were more likely to have had serious marital problems and unhappy wives. Among men who carried two copies of the gene variant, about a third had experienced a serious relationship crisis in the past year, double the number seen in the men who did not carry the variant.

Although the trait is often called the "fidelity gene," Mr. Walum called that a misnomer: his research focused on marital stability, not faithfulness. "It's difficult to use this information to predict any future behavior in men," he told me. Now he and his colleagues are working to replicate the findings and conducting similar research in women.

While there may be genetic differences that influence commitment, other studies suggest that the brain can be trained to resist temptation.

A series of unusual studies led by John Lydon, a psychologist at McGill University in Montreal, have looked at how people in a committed relationship react in the face of temptation. In one study, highly committed married men and women were asked to rate the attractiveness of people of the opposite sex in a series of photos. Not surprisingly, they gave the highest ratings to people who would typically be viewed as attractive.

Later, they were shown similar pictures and told that the person was interested in meeting them. In that situation, participants consistently gave those pictures lower scores than they had the first time around.

When they were attracted to someone who might threaten the relationship, they seemed to instinctively tell themselves, "He's not so great." "The more committed you are," Dr. Lydon said, "the less attractive you find other people who threaten your relationship."

But some of the McGill research has shown gender differences in how we respond to a cheating threat. In a study of 300 heterosexual men and women, half the participants were primed for cheating by imagining a flirtatious conversation with someone they found attractive. The other half just imagined a routine encounter.

Afterward, the study subjects were asked to complete fill-in-the-blank puzzles like LO_AL and THR__T.

Unbeknownst to the participants, the word fragments were a psychological test to reveal subconscious feelings about commitment. (Similar word puzzles are used to study subconscious feelings about prejudice and stereotyping.)

No pattern emerged among the study participants who imagined a routine encounter. But there were differences among men and women who had entertained the flirtatious fantasy. In that group, the men were more likely to complete the puzzles with the neutral words LOCAL and THROAT. But the women who had imagined flirting were far more likely to choose LOYAL and THREAT, suggesting that the exercise had touched off subconscious concerns about commitment.

Of course, this does not necessarily predict behavior in the real world. But the pronounced difference in responses led the researchers to think women might have developed a kind of early warning system to alert them to relationship threats.

Other McGill studies confirmed differences in how men and women react to such threats. In one, attractive actors or actresses were brought in to flirt with study participants in a waiting room. Later, the participants were asked questions about their relationships, particularly how they would respond to a partner's bad behavior, like being late and forgetting to call.

Men who had just been flirting were less forgiving of the hypothetical bad behavior, suggesting that the attractive actress had momentarily chipped away at their commitment. But women who had been flirting were more likely to be forgiving and to make excuses for the man, suggesting that their earlier flirting had triggered a protective response when discussing their relationship.

"We think the men in these studies may have had commitment, but the women had the contingency plan - the attractive alternative sets off the alarm bell," Dr. Lydon said. "Women implicitly code that as a threat. Men don't."

The question is whether a person can be trained to resist temptation. In another study, the team prompted male students who were in committed dating relationships to imagine running into an attractive woman on a weekend when their girlfriends were away. Some of the men were then asked to develop a contingency plan by filling in the sentence "When she approaches me, I will _____ to protect my relationship."

Because the researchers could not bring in a real woman to act as a temptation, they created a virtual-reality game in which two out of four rooms included subliminal images of an attractive woman. The men who had practiced resisting temptation gravitated toward those rooms 25 percent of the time; for the others, the figure was 62 percent.

But it may not be feelings of love or loyalty that keep couples together. Instead, scientists speculate that your level of commitment may depend on how much a partner enhances your life and broadens your horizons - a concept that Arthur Aron, a psychologist and relationship researcher at Stony Brook University, calls "self-expansion."

To measure this quality, couples are asked a series of questions: How much does your partner provide a source of exciting experiences? How much has knowing your partner made you a better person? How much do you see your partner as a way to expand your own capabilities?

The Stony Brook researchers conducted experiments using activities that stimulated self-expansion. Some couples were given mundane tasks, while others took part in a silly exercise in which they were tied together and asked to crawl on mats, pushing a foam cylinder with their heads. The study was rigged so the couples failed the time limit on the first two tries, but just barely made it on the third, resulting in much celebration.

Couples were given relationship tests before and after the experiment. Those who had taken part in the challenging activity posted greater increases in love and relationship satisfaction than those who had not experienced victory together.

Now the researchers are embarking on a series of studies to measure how self-expansion influences a relationship. They theorize that couples who explore new places and try new things will tap into feelings of self-expansion, lifting their level of commitment.

"We enter relationships because the other person becomes part of ourselves, and that expands us," Dr. Aron said. "That's why people who fall in love stay up all night talking and it feels really exciting. We think couples can get some of that back by doing challenging and exciting things together."

Tara Parker-Pope's new book is "For Better: The Science of a Good Marriage."

Running a marathon halts cellular suicide

Apoptosis, the natural 'programmed' death of cells, is arrested in the aftermath of strenuous exercise. Researchers writing in the open access journal BMC Physiology studied peripheral blood mononuclear cells (PBMCs), isolated from whole blood samples taken from people after finishing a marathon, finding that the balance between expression of pro- and anti-apoptotic genes is shifted after the race.

Gabriella Marfe from the University of Rome 'Tor Vergata' led a team of researchers who studied ten amateur athletes after a 42km run. Marfe said, "Apoptosis is a normal physiological function dependent on a variety of signals, many of which can be modulated by strenuous exercise. Here, we've shown for the first time that exercise modulates expression of the sirtuin family of proteins, which may be key regulators of training".

The researchers believe that the sirtuin family of proteins, particularly SIRT1, may be involved in the protective effects of exercise against cell death. Speaking about these results, Marfe added, "Sirtuins may play a crucial role of mediators/effectors in the maintenance of skeletal and cardiac muscle tissues as well as neurons, thus explaining the synergic protective effects of physical exercise and calorie restriction for survival and ageing".

The authors also caution that any exercise people carry out should be done properly. Marfe said, "Untrained amateur athletes often do hard training without professional advice. Such intense and exhaustive exercise can be harmful to health. In order to achieve beneficial effects, we recommend that exercise training should form part of a lifelong regime with expert medical advice and supervision".

Notes to Editors

1. The effect of marathon on mRNA expression of anti-apoptotic and pro-apoptotic proteins and sirtuins family in male recreational long-distance runners Gabriella Marfe, Marco Tafani, Bruna Pucci, Carla Di Stefano, Manuela Indelicato, Angela Andreoli, Matteo Antonio Russo, Paola Sinibaldi-Salimei and Vincenzo Manzi
BMC Physiology (in press)

Chemical remains of dinobird found

A 150-million-year old 'dinobird' fossil, long thought to contain nothing but fossilized bone and rock, has been hiding remnants of the animal's original chemistry, according to new research

Chemistry in colour **(Image: W. I. Sellers/Proceedings of the National Academy of Sciences)**

A 150-million-year old 'Dinobird' fossil, long thought to contain nothing but fossilized bone and rock, has been hiding remnants of the animal's original chemistry, according to new research.

The sensational discovery by an international team of palaeontologists, geochemists and physicists was made after carrying out state-of-the art analysis of one the world's most important fossils - the half-dinosaur/half-bird species called Archaeopteryx.

The discovery could revolutionize the field of palaeontology say the team led by scientists at The University of Manchester and the Department of Energy's SLAC National Accelerator Laboratory in the United States.

By recording how 'bright X-rays' interacted with the fossil, the team have created maps showing chemical elements which were part of the living animal itself.

The maps, published today in the journal Proceedings of National Academy of Science, show that portions of the feathers are not merely impressions of long-decomposed organic material - as was previously believed.

Instead, they include fossilized fragments of actual feathers containing phosphorous and sulfur, elements that compose modern bird feathers. Trace amounts of copper and zinc were also found in the Dinobird's bones: like birds today, the Archaeopteryx may have required those elements to stay healthy.

University of Manchester palaeontologist Dr Phil Manning said: "Archaeopteryx is to palaeontology what Tutankhamen is to archaeology. It's simply one of the icons of our field. "You would think after 150 years of study, we'd know everything we need to know about this animal. But guess what - we were wrong."

Lead author geochemist Dr Roy Wogelius from The University of Manchester said: "We talk about the physical link between birds and dinosaurs, and now we have found a chemical link between them.

"In the fields of palaeontology and geology, people have studied bones for decades. But this whole idea of the preservation of trace metals and the chemical remains of soft tissue is quite exciting."

The researchers found significantly different concentrations of elements in the fossil than in the surrounding rock, confirming they are remnants of the Dinobird and not leached from the surrounding rock into the fossil.

SLAC physicist Uwe Bergmann, who led the X-ray scanning experiment, said: "People have never used a technique this sensitive on Archaeopteryx before. "Because the SSRL beam is so bright, we were able to see the teeniest chemical traces that nobody thought were there."

CMW Institute researcher Bob Morton said: "The discovery that certain fossils retain the detailed chemistry of the original organisms offers scientists a new avenue for learning about long-extinct creatures.

As a result, say the team, the research could change the way palaeontologists work.

Dr Wogelius added: "We're able to read so much more into these organisms now using this technology - we're literally touching ghosts. "Chemistry is the real key in the future of palaeontology. It's a paradigm shift."

Dr Manning added: "I wouldn't be surprised if future excavations look more like CSI investigations where people look for clues at a scene of a crime. "There's info that's still there that can't be seen with the naked eye.

"We can only see these valuable pieces of data using the x-ray vision that the synchrotron provides."

Notes For Editors

This research was conducted by Uwe Bergmann (SLAC), Bob Morton (CMW Institute), Phil Manning (University of Manchester and University of Pennsylvania), William Sellers (University of Manchester), Sam Farrar (Black Hills Institute of Geological Research), Ken Huntley (CMW Institute), Roy Wogelius (University of Manchester), and Peter Larson (University of Manchester and Black Hills Institute of Geological Research). The collaboration wishes to thank the Wyoming Dinosaur Centre, which loaned the fossil for analysis; and the Black Hills Institute of Geological Research, which arranged the loan.

Panel recommends standardizing prescription container labeling

Format, appearance, content and language covered in recommendations to help address problem of poor health literacy

Rockville, Md., To promote the establishment of universal standards for prescription medication labels - and to address the widespread problem of patient misinterpretation of medication instructions - an advisory panel formed by the U.S. Pharmacopeial Convention (USP) recently issued a set of recommendations to bring consistency to labeling on dispensed prescription packaging. The recommendations are patient-centered, and were developed following a call for such standards by the Institute of Medicine (IOM) on the issue of health literacy. The recommendations were presented to the IOM Health Literacy Roundtable.

Limited health literacy has been cited as a major problem by IOM, which states that 90 million adults are affected. Those with limited health literacy cannot fully benefit from much that the health and health care system have to offer, according to IOM. One critical component to health literacy is the ability to properly understand medication instructions and important supplemental information (such as drug interactions). Poor health literacy can lead to non-adherence and medication errors, which may pose significant health risks to patients. Medication misuse results in over 1 million adverse drug events per year.

USP, a nonprofit scientific organization that sets legally enforceable standards for the identity, as well as the strength, quality and purity of medicines in the United States, formed a Health Literacy and Prescription Container Labeling Advisory Panel in 2007 to examine ways to improve prescription drug container labeling. USP recently released the panel's recommendations, which cover format, appearance, content and language of prescription labels - all of which contribute to optimal patient understanding, which leads to safe and effective use of medications.

"Patients have the right to understand health information that is necessary to safely care for themselves and their families," said Joanne G. Schwartzberg, M.D., co-chair of the USP Health Literacy and Prescription Container Labeling Advisory Panel. "Confusing medication labels is one area that can be improved considerably. As most of us who have ever received a prescription drug know, the content and appearance of medication labels can vary widely. Sometimes, there is so much information included that it can be difficult to find the most essential information - the directions for use. By standardizing labels of medications so that they provide reliable, simple and concise information, I think we can significantly advance patient health and safety."

The recommendations by the advisory panel include:

* Organize the Prescription Label in a Patient-Centered Manner. Information must be organized in a way that best reflects how most patients seek out and understand medication instructions. Prescription container labeling should feature only the most critical patient information needed for safe and effective understanding and use.

* Simplify Language. To improve patient understanding and safe and effective prescription medication use, language on the label should be clear, simplified, concise and standardized. Only common terms and sentences should be used. Use of unfamiliar words (including Latin terms) and unclear medical jargon should be avoided. Ambiguous directions such as "take as directed" should be avoided unless clear and unambiguous supplemental instructions and counseling are provided.

* Use Explicit Text to Describe Dosage/Interval Instructions. Dosage, usage and administration instructions must clearly separate dose from interval and must provide the explicit frequency of drug administration (e.g., "Take 4 tablets each day. Take 2 tablets in the morning and 2 tablets in the evening" is better than "Take two tablets by mouth twice daily"). Use numeric rather than alphabetic characters for numbers.

* Include Purpose for Use. Confidentiality and FDA approval for intended use (e.g., labeled versus off-label use) may limit inclusion of indications on drug product labels. Current evidence supports inclusion of purpose-for-use language in clear, simple terms. Therefore, the prescriber's intended purpose of use/indication should be included on the prescription whenever possible and should be stated in clear, simple language (e.g., for high blood pressure, for rash or for stomach cramps).

* Improve Readability. Critical information for patients must appear on the prescription label in an uncondensed, simple, familiar, minimum 12-point, sans serif font (e.g., Arial) that is in sentence case (i.e., punctuated like a normal sentence in English: initial capital followed by lower-case letters except for proper nouns, acronyms, etc.). Field size (examples of "fields" include patient name and directions for use) and font size may be increased in the best interest of patient care. Critical information should never be truncated.

* Provide Labeling in Patient's Preferred Language. Whenever possible, prescription container labeling should be provided in a patient's preferred language. Translations of labels should be produced using a high-quality translation process.

* Include Supplemental Information. Auxiliary information on the prescription container should be minimized and should be limited to evidence-based critical information. The information should be presented in a standardized manner and should be necessary for patient understanding. This is important because of the extensive variability in the content and application of supplemental information, the lack of scientific evidence for these labels, and the potential ambiguity and failure to address specific patient needs.

* Standardize Directions to Patients. In recognition of the nation's move toward e-prescribing, standards should be developed for prescribing directions to patients. This would lead to consistency of language and use across all health care professionals and systems. An important element is the elimination of Latin abbreviations, which are often misunderstood and susceptible to variation in translation.

The USP panel, which is co-chaired by Dr. Schwartzberg and Gerald McEvoy, Pharm.D., is composed of a group of experts in the fields of health literacy, health policy and medication safety. The panel members are: Cynthia Brach; Sandra Leal, Pharm.D., CDE; Linda Lloyd, M.Ed.; Melissa Madigan, Pharm.D., J.D.; Dan Morrow, Ph.D.; Ruth Parker, M.D.; Cynthia Raehl, Pharm.D., FASHP, FCCP; William Shrank, M.D., MSHS; Patricia Sokol, R.N., J.D.; Darren Townzen, R.Ph., MBA; Jeanne Tuttle, R.Ph.; Joan E. Kapusnik-Uner, Pharm.D., FCSHP; Michelle Weist, Pharm.D., BCPS; and Michael Wolf, Ph.D., MPH.

Stray grey whale navigates the North-West Passage

* 11:26 11 May 2010 **by Fred Pearce**

Conventional wisdom has it that grey whales have been extinct in the Atlantic Ocean for more than 200 years, and the species survives only in the north Pacific. That was the case until last weekend, when a 13-metre-long grey whale was spotted cruising off the coast of Israel.

"This is sensational," said Phillip Clapham of the US government's National Marine Mammal Laboratory in Seattle after hearing the news from marine biologists in Israel. "The most plausible explanation is that it came across an ice-free North-West Passage from the Pacific Ocean, and is now wondering where the hell it is."

The North-West Passage, which runs through the Canadian Arctic, has been open in summer in recent years, partly because of rising global temperatures.

Although they are known for their long migrations, grey whales do not normally stray from their regular routes. "Were I to speculate wildly, I'd say it found Europe and remembered its mother telling it to keep the coast to its left going south, then it hit the strait of Gibraltar and entered the Mediterranean," said Clapham.

The Arctic route makes most sense, agrees Giuseppe Notarbartolo di Sciara, an expert on Mediterranean cetaceans who advises several international conservation bodies. He points to reports that grey whales have been seen getting farther north than usual into the Arctic, probably helped by the low-ice conditions.

"Probably this one went so far east that when the time came to go south it had the Atlantic rather than the Pacific in front of its rostrum," says di Sciara. "Then, hugging the eastern side of the ocean as any good Pacific grey whale would do, it went into the first big warmish 'lagoon' it could find: the Mediterranean."

Incredible but inescapable

The finding was announced last Saturday by Aviad Scheinin, chairman of the Israel Marine Mammal Research and Assistance Center, who had followed the whale at sea for 2 hours. He at first thought it was a sperm whale, but checked the markings back on land and reached the "incredible but inescapable conclusion that it was a grey whale". Clapham told New Scientist that the identification had now been confirmed.

There are two distinct populations of grey whales in the northern Pacific Ocean, one on the Asian side and one on the American. A third population inhabited the Atlantic shores of North America and Europe until the 18th century, when it seems to have been hunted to extinction by American and European whalers. Archaeologists have found fossil remains in the Mediterranean, where the whales probably calved.

The discovery of a Pacific grey whale so far from home may revive calls to reintroduce the species to European waters. In 2005, Owen Nevin and Andrew Ramsey of the University of Central Lancashire in Preston, UK, proposed airlifting grey whales from the population in the eastern Pacific to the Irish Sea (PDF).

Conservationists at the time questioned whether the animals would survive in the Atlantic. That question, at least, seems to have been answered.

Did phosphorus trigger complex evolution - and blue skies?

Washington, D.C. - The evolution of complex life forms may have gotten a jump start billions of years ago, when geologic events operating over millions of years caused large quantities of phosphorus to wash into the oceans. According to this model, proposed in a new paper by Dominic Papineau of the Carnegie Institution for Science, the higher levels of phosphorus would have caused vast algal blooms, pumping extra oxygen into the environment which allowed larger, more complex types of organisms to thrive.

"Phosphate rocks formed only sporadically during geologic history," says Papineau, a researcher at Carnegie's Geophysical Laboratory, "and it is striking that their occurrences coincided with major global biogeochemical changes as well as significant leaps in biological evolution."

In his study, published in the journal Astrobiology, Papineau focused on the phosphate deposits that formed during an interval of geologic time known as the Proterozoic, from 2.5 billion years ago to about 540 million years ago. "This time period is very critical in the history of the Earth, because there are several independent lines of evidence that show that oxygen really increased during its beginning and end," says Papineau. The previous atmosphere was possibly methane-rich, which would have given the sky an orangish color. "So this is the time that the sky literally began to become blue."

During the Proterozoic, oxygen levels in the atmosphere rose in two phases: first ranging from 2.5 to 2 billion years ago, called the Great Oxidation Event, when atmospheric oxygen rose from trace amounts to about 10% of the present-day value. Single-celled organisms grew larger during this time and acquired cell structures called mitochondria, the so-called "powerhouses" of cells, which burn oxygen to yield energy. The second phase of oxygen rise occurred between about 1 billion and 540 million years ago and brought oxygen levels to near present levels. This time intervals is marked by the earliest fossils of multi-celled organisms and climaxed with the spectacular increase of fossil diversity known as the "Cambrian Explosion."

Papineau found that these phases of atmospheric change corresponded with abundant phosphate deposits, as well as evidence for continental rifting and extensive glacial deposits. He notes that both rifting and climate changes would have changed patterns of erosion and chemical weathering of the land surface, which would have caused more phosphorous to wash into the oceans. Over geologic timescales the effect on marine life, he says, would have been analogous to that of high-phosphorus fertilizers washed into bodies of water today, such as the Chesapeake Bay, where massive algal blooms have had a widespread impact.

"Today, this is happening very fast and is caused by us," he says, "and the glut of organic matter actually consumes oxygen. But during the Proterozoic this occurred over timescales of hundreds of millions of years and progressively led to an oxygenated atmosphere."

"This increased oxygen no doubt had major consequences for the evolution of complex life. It can be expected that modern changes will also strongly perturb evolution," he adds. "However, new lineages of complex life-forms take millions to tens of millions of years to adapt. In the meantime, we may be facing significant extinctions from the quick changes we are causing."

The research was supported by the Geophysical Laboratory of the Carnegie Institution for Science, Carnegie of Canada, and from the Fonds québécois pour la recherche sur la nature et les technologies (FQRNT), NASA Exobiology and Evolutionary Biology Program, and the NASA Astrobiology Institute through Cooperative Agreement NNA04CC09A.

For comfort, mom's voice works as well as a hug

MADISON - "Reach out and touch someone" - good advertising slogan, or evolutionary imperative?

How about both?

What Madison Avenue knew decades ago has been observed in brain chemistry. A simple phone call from mom can calm frayed nerves by sparking the release of a powerful stress-quelling hormone, according to researchers at the University of Wisconsin-Madison.

Biological anthropologist Leslie Seltzer tested a group of seven- to 12-year-old girls with an impromptu speech and series of math problems in front of a panel of strangers, sending their hearts racing and levels of cortisol - a hormone associated with stress - soaring.

"Facing a challenge like that, being evaluated, raises stress levels for a lot of people," says Seth Pollak, psychology professor and director of UW-Madison's Child Emotion Lab.

Once stressed, one-third of the girls were comforted in person by their mothers - specifically with hugs, an arm around the shoulders and the like. One-third were left watch an emotion-neutral 75-minute video. The rest were handed a telephone. It was mom on the line, and the effect was dramatic.

"The children who got to interact with their mothers had virtually the same hormonal response, whether they interacted in person or over the phone," Seltzer says.

The girls' levels of oxytocin, often called the "love hormone" and strongly associated with emotional bonding, rose significantly and the stress-marking cortisol washed away.

"It was understood that oxytocin release in the context of social bonding usually required physical contact," Seltzer says. "But it's clear from these results that a mother's voice can have the same effect as a hug, even if they're not standing there."

And the reprieve from stress or anxiety is a lasting one.

"It stays well beyond that stressful task," Pollak says. "By the time the children go home, they're still enjoying the benefits of this relief and their cortisol levels are still low."

The findings - which were published Wednesday in the journal Proceedings of the Royal Society B - square with a "tend and befriend" theory explaining how stress regulation may differ between males and females. Confronted with a threat, males may be more likely to choose between fight and flight. A female with offspring in tow or slowed by pregnancy, however, may have to make different choices.

"You might not be able to run with a child or defend yourself without endangering both of you," Seltzer said.

Instead, Seltzer explained, it might make more sense for a female to create or use a social bond to deal with a stressor - either through touch or soothing vocal communication.

"Apparently this hormone, oxytocin, reduces stress in females after both types of contact, and in doing so may strengthen bonds between individuals," she said.

From a modern perspective, the new understanding of oxytocin release helps explain the popularity of tearjerker long distance telephone commercials and shifts Pollak's reaction to his own students.

"For years I've seen students leaving exams and the first thing they do is pull out their cell phone and make a call," Pollak says. "I used to think, 'How could those over-attentive, helicopter parents encourage that?' But now? Maybe it's a quick and dirty way to feel better. It's not pop psychology or psychobabble."

"It's hard to get cortisol up. It's hard to get oxytocin up," he says. "That a simple telephone call could have this physiological effect on oxytocin is really exciting."

UW-Madison endocrinologist and study co-author Toni Ziegler developed with Seltzer a non-invasive test to measure oxytocin levels without inducing more stress in study subjects.

Seltzer has moved on to testing the oxytocin wake of other communication methods - like text messaging - and hopes to see the research spread out from human subjects

"It's not just us, of course. Lots of very social species vocalize," she says. "On the one hand, we're curious to see if this effect is unique to humans. On the other we're hoping researchers who study vocal communication will consider looking at oxytocin release in other animals and applying it to broader questions of social behavior and evolutionary biology."

A woman's touch: Physical contact increases financial risk taking

A woman's touch is all it takes for people to throw caution to the wind. That's the conclusion of a new study published online in Psychological Science, a journal of the Association for Psychological Science. If a female experimenter patted a participant on the back, they'd risk more money than if she just talked to them, or if a man did the patting. The researchers think this comes from the way that mothers use touch to make their babies feel secure.

When we are infants, we receive a lot of touch from our mothers. This creates a sense of attachment, which makes a baby feel secure. This helps the youngster's sense of adventure; they're more willing to take the risks that come with exploring unfamiliar contexts and strange situations. Jonathan Levav of Columbia University and Jennifer J. Argo of the University of Alberta wanted to know what happens when those babies grow up: Does physical contact also affect how willing adults are to take risks?

Participants were tested to see if they would take risks, such as investing money or taking a gamble. When they started the experiment, they were greeted in different ways: by a female or male experimenter and with a light, comforting touch on the shoulder, a handshake, or no physical contact at all. At the end of the experiment, they also filled out surveys that assessed how secure they felt. The researchers found that participants who were touched felt more secure and took bigger risks than those who weren't – but only if they were touched by a woman. The effect was stronger for a touch on the back than for a handshake, but went away entirely for participants who were touched by a man.

The results suggest that a woman's touch works the same on adults as it does on infants: making them feel more secure and more willing to take risks.

Green machine: Cementing greener construction

* 17:34 11 May 2010 **by Helen Knight**

Green machine is our new weekly column on the latest advances in environmental technologies

As far as clean technologies go, a dollop of cement sounds unlikely to be at the cutting edge. And with good reason: cement production accounts for 5 per cent of global carbon emissions. So it follows that better building materials could go a long way towards cleaning up the atmosphere.

Today companies around the world are vying to be the first to commercialise cements that can be made either by absorbing more than their production generates, or without emitting carbon dioxide at all.

Calix, based in Sydney, Australia, this week filed a patent on a process to produce "green" cement through the rapid calcination of calcium magnesium carbonate particles, known as dolomite.

The particles are dropped into a vertical tube full of superheated steam, which causes the particles to explode into grains, increasing the overall surface area. Those grains then react with the steam, oxidising the surfaces,

says Calix's chief scientist Mark Sceats. The residue is then ground into a powder and mixed with sand to form a powder known as Semidolime. To produce the cement, Semidolime is mixed with water and power-plant flue gas, which typically contains significant levels of CO2.

Low energy

The use of superheated steam results in an energy-efficient method to manufacture cement – the fuel and electricity used during the process generates 14 kilograms of CO2 for every tonne of concrete ultimately produced, the company claims.

The process does, however, release a pure stream of CO2, but this can be captured and compressed for geological storage, says Sceats. What is more, this cement absorbs 21 kilograms of CO2 per tonne of material as it hardens into concrete of the desired shape. The net result is that for every tonne of concrete produced, the material removes 7 kilograms of CO2 from the atmosphere.

The company is building a commercial site to produce the Semidolime, at Bacchus Marsh in Victoria, Australia, in which the captured CO2 will be reused to set concrete slabs.

Hard water

Calix is not the only company with an eye on making cement a net absorber of CO2.

"I would never have thought we would invest in cement, until someone came to me and told me they could reinvent cement and make it carbon negative," said venture capitalist Vinod Khosla of Khosla Ventures at the Green:Net conference in San Francisco last month.

Khosla Ventures has invested in Calera, based in Los Gatos, California, which has developed a technique to absorb the CO2 in hot power-plant flue gas with hard water to make cement.

The CO2 reacts with the calcium and magnesium in the water to form solid carbonates and bicarbonates, which are then removed from the water and processed for use as cement, without any CO2 having been produced in the process.

Changing the building blocks

Meanwhile London-based Novacem, a spin-out of Imperial College London, has replaced the limestone used in conventional Portland cement with magnesium silicates. "Given that there is 2.9 billion tonnes of Portland cement produced [worldwide] every year, we're talking about 2 billion tonnes of CO2 that the industry produces," says Novacem's John Prendergast.

Half of that CO2 is released in the calcination of limestone; the other half comes from the fuel used to heat the reaction. Magnesium silicates, in contrast, release far less CO2 when heated.

To produce cement, the magnesium silicates are heated to 180 °C, causing them to form magnesium carbonates. These are then further heated to 700 °C to produce magnesium oxide, producing a small amount of CO2 in the process. The resulting cement is a mixture of this magnesium oxide and some magnesium silicates.

Generating those sorts of temperatures is also less energy-hungry than Portland cement production, where limestone is heated with clay and sand to 1450 °C. Low-carbon alternatives such as biomass can be used to reach the 700 °C needed to produce Novacem's cement, says Prendergast. "Novacem actually absorbs 100 kilograms of CO2 per tonne of cement," he says.

The company has recently built a small pilot plant at Imperial College, which is now producing a few kilograms of cement per day. It hopes to begin operating a semi-commercial plant in 2012.

In the meantime, Novacem is adjusting the composition of the material to increase its strength. At the moment the cement produced is strong enough for a range of non-structural applications such as paving stones, but within a year the company believes it will be suitable for use in more demanding applications. The cement should be no more expensive to produce than Portland cement, it claims.

Witness brain scan won't reveal whether the face fits

* 18:25 11 May 2010 **by Wendy Zukerman**

Having trouble picking out the guilty party? A brain scan won't help.

Jesse Rissman and his team at Stanford University in California have found that monitoring brain activity of witnesses reveals no more than what they say they remember.

The study comes amid controversy over whether to admit functional MRI scans as evidence in US courts.

Last week, an attorney in New York City attempted to use a brain scan to demonstrate the truthfulness of a witness in an employment case, but failed on a separate legal technicality. And this week, a judge in a federal case in Tennessee was due to decide whether to admit fMRI evidence in a fraud case; if successful, this would be the first time a court anywhere in the world accepted this type of scan.

The Stanford team asked 16 volunteers to view 200 mugshots.

An hour later, they were again shown pictures of faces, some of which they had seen before and others that were new. The researchers recorded fMRI scans of the volunteers' brains as they reported which faces they recognised.

While the brain scans matched the volunteers' decisions on whether the faces were familiar, they could not predict if the recollection was accurate. The team also don't know how easily a witness could cheat the system: remembering a recent event or fabricating a lie may look the same to the scanner.

Journal reference: Proceedings of the National Academy of Sciences, DOI: 10.1073/pnas.1001028107

High-dose vitamin D linked with increased risk of falls, fractures among older women

Women age 70 years or older who received a single annual high dose of vitamin D had a higher rate of falls and fractures compared to women who received placebo, according to a study in the May 12 issue of JAMA.

The results of studies investigating the effects of cholecalciferol (vitamin D) supplementation on falls and fractures have been inconsistent, with some meta-analyses indicating a reduced fracture risk, while others have concluded that vitamin D supplementation is ineffective, or may increase the risk of fracture. For individuals attempting to modify their risk of falls or fractures via vitamin D, adherence to daily supplementation is typically poor, according to background information in the article.

Kerrie M. Sanders, Ph.D., of the University of Melbourne, Geelong, Australia and colleagues conducted a study to examine whether high-dose cholecalciferol (500,000 IU) given orally once a year to older women would reduce falls and fractures. The vitamin D was given in a single, high-dose to address low adherence and to be a practical intervention easily translated to clinical practice. The trial included 2,256 community-dwelling women, ages 70 years or older, considered to be at high risk of fracture, who were recruited from June 2003 to June 2005 and were randomly assigned to receive 500,000 IU of cholecalciferol or placebo each autumn to winter for 3 to 5 years. The study concluded in 2008.

The trial participants had a total of 5,404 falls over the study period, with 74 percent of 837 women in the vitamin D group and 68 percent of 769 women in the placebo group having at least 1 fall. Analysis indicated women in the annual high-dose vitamin D group experienced 15 percent more falls. Women in the vitamin D group had 171 fractures vs. 135 in the placebo group, with 26 percent more fractures for participants in the vitamin D group, who also had a 31 percent higher incidence of falls in the first 3 months following dosing.

"This is the first study to demonstrate increased risk of falls associated with any vitamin D intervention and the second study to demonstrate an increased fracture risk associated with annual high-dose vitamin D therapy in elderly women. Our study used the largest total annual dose of vitamin D (500,000 IU) reported in any large randomized controlled trial, raising the possibility that the adverse outcome is dose-related. The opposing outcomes of 2 studies that used the same total annual dose (300,000 IU intramuscularly) suggest that the dosing regimen (i.e., 4 monthly vs. annually) rather than the total dose might determine the outcome," the authors write.

"This line of reasoning is supported by the temporal risk pattern that we observed and the fact that harm has not been reported in the numerous studies that have used more frequent dosing. Thus, it is reasonable to speculate that high serum levels of vitamin D or metabolites resulting from the large annual dose, subsequent decrease in the levels, or both might be causal. Furthermore, because the levels of 25-hydroxycholecalciferol demonstrated in this study could occur with other recommended dosing regimens, the outcome of this study suggests that safety of high-dose vitamin D supplementation warrants further study."

(JAMA. 2010;303[18]:1815-1822. Available pre-embargo to the media at www.jamamedia.org)

Editor's Note: *Please see the article for additional information, including other authors, author contributions and affiliations, financial disclosures, funding and support, etc.*

Editorial: High-Dose Vitamin D Supplementation - Too Much of a Good Thing?

Bess Dawson-Hughes, M.D., and Susan S. Harris, D.Sc.. of Tufts University, Boston, write in an accompanying editorial that the study by Sanders et al underscores the importance of continuing to improve understanding of basic vitamin D physiology, particularly as it relates to the increased variety of supplement forms that have become available by prescription and over-the-counter.

"Specifically, the effect of dose size, route (intramuscular vs. oral), and dosing interval on aspects of vitamin D metabolism including CYP24 activity and on local tissue-specific 1,25-dihydroxyvitamin D levels and actions should be investigated. It may also be necessary to reevaluate the risks and benefits of the current clinical practice of providing high loading doses of cholecalciferol to patients who are vitamin D deficient. In the meantime, it is important to reiterate that although vitamin D insufficiency is widespread, it can be safely corrected with a variety of existing supplement types and regimens and it should continue to be identified and treated in clinical practice."

(JAMA. 2010;303[18]:1861-1862. Available pre-embargo to the media at www.jamamedia.org)

The Claim: 'White-Coat Hypertension' Is Nothing to Worry About

By ANAHAD O'CONNOR

THE FACTS Going to the doctor can be nerve-racking. So much so that for some patients it causes a rise in blood pressure that gives the appearance of hypertension.

The old thinking was that if one's blood pressure was high at the doctor's office but otherwise normal, there was no reason for concern. Chalk it up to the jitters.

But a new school of thought has emerged. "White-coat hypertension" may be more than a false positive: it may help identify people at serious risk for the real thing. In studies, researchers have found that patients whose blood pressure rises to abnormal levels in a clinical setting are far more likely to develop hypertension than those with normal readings at home and at the clinic.

In a 2005 study in The Archives of Internal Medicine, a team of scientists followed about 800 people for eight years, 128 of them with white coat hypertension: readings above 140 over 90 in the doctor's office, and below 135/85 when measured over a 24-hour period at home. The other subjects had normal pressure (they were normotensive) in both settings.

After eight years, the scientists found that only 20 percent from the normal group progressed to actual hypertension, compared with 47 percent from the white-coat group - "suggesting," the researchers wrote, "that white-coat hypertension may carry a poor cardiovascular prognosis."

A 2009 study of 1,400 people over 10 years in the journal Hypertension had similar results. The reason is unclear. But one hypothesis is that people with white-coat hypertension are more susceptible to stress, which can lead to higher blood pressure over time.

THE BOTTOM LINE White-coat hypertension can be a forerunner of sustained high blood pressure.

Scientists design new drug type to kill lymphoma cells

Three researchers who are recipients of a collaborative grant from the Samuel Waxman Cancer Research Foundation have developed a new type of drug designed to kill non-Hodgkin lymphoma tumor cells. The breakthrough could lead to potential non-toxic therapies for cancer patients. The Foundation-funded investigators include Ari Melnick, M.D., of Weill Cornell Medical College, Alexander MacKerell, Ph.D., of the University of Maryland and Gilbert Privé, Ph.D., of the University of Toronto. The researchers, who published their findings in the April issue of Cancer Cell, have identified a drug that targets an oncogene known as BCL6.

BCL6 functions as a master regulatory protein. "It's a protein that controls the production of thousands of other genes," said Dr. Melnick, an associate professor of medicine at Weill Cornell Medical College in New York City. "Because of that, it has a very profound impact on cells and is required for lymphoma cells to survive and multiply."

BCL6 causes the majority of diffuse large B cell lymphomas, the most common form of non-Hodgkin lymphoma. Currently, about 60 percent of diffuse large B cell lymphomas can be cured with chemo-immunotherapy, said Dr. Melnick. "The hope is that we can improve that to a higher percent, and in the long term reduce the need for chemotherapy," he added.

Traditional cancer drugs target enzymes, which have small pockets on their surfaces that can be blocked with molecules. Until now, pharmaceutical companies have been reluctant to create drugs that target a protein like BCL6 because they function through a different mechanism involving interactions with cofactor proteins involving extensive protein surfaces. "And because the real estate covered by these interactions is so large, the drug companies have viewed these as being not druggable targets," said Dr. Melnick.

He and his colleagues were able to identify a "hot spot" on BLC6 that they predicted would play a critical role in protein interactions. They showed that their BCL6 inhibitor drug was specific to BCL6, and did not block other master regulatory proteins. The drug had powerful lymphoma killing activity and yet was non-toxic to normal tissues. "This is the first time a drug of this nature has been designed and it shows that it's not actually impossible to target factors like BCL6," he said.

Emerging data from other investigators suggests that BCL6 is important in many other tumor types, including forms of leukemia.

"The Samuel Waxman Cancer Research Foundation has always supported the collaborative work of scientists, funding innovative cancer research grants," said Samuel Waxman, M.D., the scientific director of the Foundation. "The Foundation has supported the work of Alexander MacKerell, Ari Melnick and Gilbert Privé for a number of years because we believe their work highlights the critical and important mission of our organization - that collaboration can lead to potential effective cures."

Neanderthals not the only apes humans bred with

* 12 May 2010 **by Ewen Callaway**

A LONG-awaited rough draft of the Neanderthal genome has revealed that our own DNA contains clear evidence that early humans interbred with Neanderthals.

Such interminglings have been suspected in the past, but there's more: Neanderthals were probably not the only other Homo species early Homo sapiens mixed with.

These findings call into question the familiar story that modern humans left Africa around 100,000 years ago and swept aside all other Homo species as they made their way around the globe. "It was a very simple story," says João Zilhão at the University of Bristol, UK. "Its simplicity suggested it would not be true." A more likely scenario is that as H. sapiens migrated, they met and interbred with other Homo species that have all since died out.

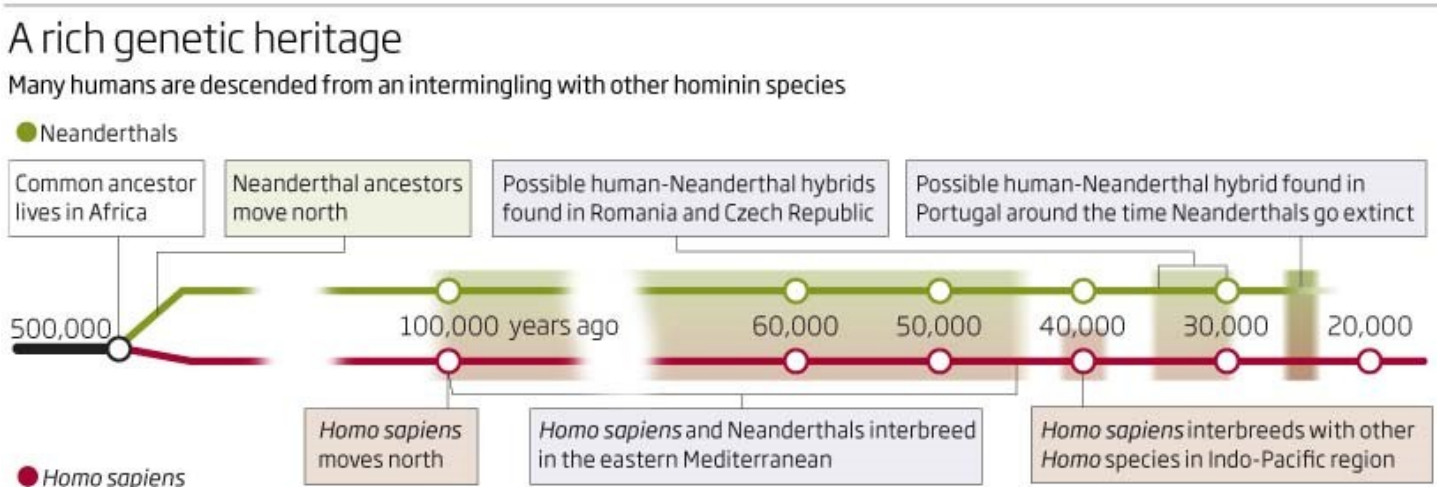
The first definitive evidence of interbreeding comes from Svante Pääbo's team at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany. They reported last week that the genome of humans today is roughly 1 to 4 per cent Neanderthal (Science, vol 328, p 710). This holds true for all non-Africans, suggesting that H. sapiens and Neanderthals interbred sometime between 100,000 and 45,000 years ago, after the first humans left Africa but before they split into regional populations.

Another genetic study confirms this. Jeffrey Long at the University of New Mexico in Albuquerque presented results from nearly 100 modern human populations at a meeting of the American Association for Physical Anthropologists in April. His team found evidence that Eurasians acquired genetic diversity from breeding with other Homo species after they left Africa.

They also noticed a spike in genetic diversity in Indo-Pacific peoples, dating to around 40,000 years ago. This time, it's unlikely the diversity came from H. sapiens getting it on with Neanderthals, who never travelled that far south. That leaves a number of candidates, including Homo erectus and species related to Homo floresiensis, a small species which lived on an Indonesian island until about 13,000 years ago.

Neither Pääbo nor Long were able to show that when humans arrived in Europe they mixed with resident Neanderthals, but archaeological finds tell a different story, says Zilhão. In Portugal, his team discovered the 25,000-year-old bones of a child they are convinced is a human-Neanderthal hybrid. Zilhão says fossils from Romania and the Czech Republic also bear Neanderthal features, though others dispute this.

Moreover, decorative artefacts characteristic of humans have cropped up at Neanderthal sites, dated to around the time of contact with humans in Africa and the Middle East. Further east, 40,000-year-old human bones from a cave near Beijing, China, have features that recall other Homo species, says Erik Trinkaus of Washington University in St Louis, Missouri.



In March, Pääbo's team reported the discovery of DNA from a hominin that is probably neither human nor Neanderthal that lived 50,000 to 30,000 years ago in a cave in southern Siberia. They dubbed the creature X-woman, and sequencing machines are already decoding its genome, says Pääbo's colleague Ed Green of the University of California, Santa Cruz. Could X-woman or its kind have bred with humans, too? "Stay tuned," Green says.

Welcome to the family, Homo sapiens neanderthalensis

WE HUMANS like to see ourselves as special, at the very pinnacle of all life. That makes us keen to keep a safe distance between ourselves and related species that threaten our sense of uniqueness. Unfortunately, the evidence can sometimes make that difficult.

Decades ago, when the primatologist Jane Goodall told anthropologist Louis Leakey that chimps used sticks to scoop up termites, he wrote: "Now we must redefine tool, redefine man or accept chimpanzees as human." The news this month that humans and Neanderthals interbred (see "Revealed: the cavemen that live on in all of us") presents us with a similar conundrum - only this one lies far closer to home. Must we now consider Neanderthals as one of our own, another twig on the branch called Homo sapiens?

Svante Pääbo, the pioneer of palaeogenetics, equivocated when a reporter asked whether his genome study suggested Neanderthals are the same species as us: "I would more see them as a form of humans that were a bit more different than people are from each other today, but not that much."

Why so shy? Putting aside the vexing question of what defines a species - which flummoxed even Linnaeus and Darwin - it is hard to see why Neanderthals should now be considered as anything other than Homo sapiens. We know that Neanderthals bred with our ancestors and produced fertile offspring, which is one hallmark of a species. And there is plenty more evidence to support giving them the status of Homo sapiens neanderthalensis.

Neanderthals shared a common ancestor with modern humans around 500,000 years ago. Its descendants went their separate ways as the Neanderthals adapted to colder climes, but then, at least 50,000 years ago, they resumed relations in the eastern Mediterranean, where the two populations met again. This pattern wouldn't necessarily merit separate species status for most animals, so why for us and Neanderthals?

There is, of course, more to the concept of being human than ecology and genetics: we are human because we think, talk, love and believe. It is impossible to know the mental life of a Neanderthal, but there is reason to think that it was not so different from our own. The Neanderthal genome differed little from ours, encoding fewer than 100 changes that would affect the shape of proteins.

True, some of these differences occur in genes linked to brain function, but similar variation is found among humans today. Moreover, Neanderthals share with us a version of a gene linked to the evolution of speech, and recent archaeological evidence suggests that their minds were capable of the symbolic representations that underlie language and art. If that's not human, then what is?

Mapping Ancient Civilization, in a Matter of Days

By JOHN NOBLE WILFORD

For a quarter of a century, two archaeologists and their team slogged through wild tropical vegetation to investigate and map the remains of one of the largest Maya cities, in Central America. Slow, sweaty hacking with machetes seemed to be the only way to discover the breadth of an ancient urban landscape now hidden beneath a dense forest canopy.

Even the new remote-sensing technologies, so effective in recent decades at surveying other archaeological sites, were no help. Imaging radar and multispectral surveys by air and from space could not “see” through the trees.

Then, in the dry spring season a year ago, the husband-and-wife team of Arlen F. Chase and Diane Z. Chase tried a new approach using airborne laser signals that penetrate the jungle cover and are reflected from the ground below. They yielded 3-D images of the site of ancient Caracol, in Belize, one of the great cities of the Maya lowlands.

In only four days, a twin-engine aircraft equipped with an advanced version of lidar (light detection and ranging) flew back and forth over the jungle and collected data surpassing the results of two and a half decades of on-the-ground mapping, the archaeologists said. After three weeks of laboratory processing, the almost 10 hours of laser measurements showed topographic detail over an area of 80 square miles, notably settlement patterns of grand architecture and modest house mounds, roadways and agricultural terraces.

“We were blown away,” Dr. Diane Chase said recently, recalling their first examination of the images. “We believe that lidar will help transform Maya archaeology much in the same way that radiocarbon dating did in the 1950s and interpretations of Maya hieroglyphs did in the 1980s and ’90s.”

The Chases, who are professors of anthropology at the University of Central Florida in Orlando, had determined from earlier surveys that Caracol extended over a wide area in its heyday, between A.D. 550 and 900. From a ceremonial center of palaces and broad plazas, it stretched out to industrial zones and poor neighborhoods and beyond to suburbs of substantial houses, markets and terraced fields and reservoirs.

This picture of urban sprawl led the Chases to estimate the city’s population at its peak at more than 115,000. But some archaeologists doubted the evidence warranted such expansive interpretations.

“Now we have a totality of data and see the entire landscape,” Dr. Arlen Chase said of the laser findings. “We know the size of the site, its boundaries, and this confirms our population estimates, and we see all this terracing and begin to know how the people fed themselves.”

The Caracol survey was the first application of the advanced laser technology on such a large archaeological site. Several journal articles describe the use of lidar in the vicinity of Stonehenge in England and elsewhere at an Iron Age fort and American plantation sites. Only last year, Sarah H. Parcak of the University of Alabama at Birmingham predicted, “Lidar imagery will have much to offer the archaeology of the rain forest regions.”

The Chases said they had been unaware of Dr. Parcak’s assessment, in her book “Satellite Remote Sensing for Archaeology” (Routledge, 2009), when they embarked on the Caracol survey. They acted on the recommendation of a Central Florida colleague, John F. Weishampel, a biologist who had for years used airborne laser sensors to study forests and other vegetation.

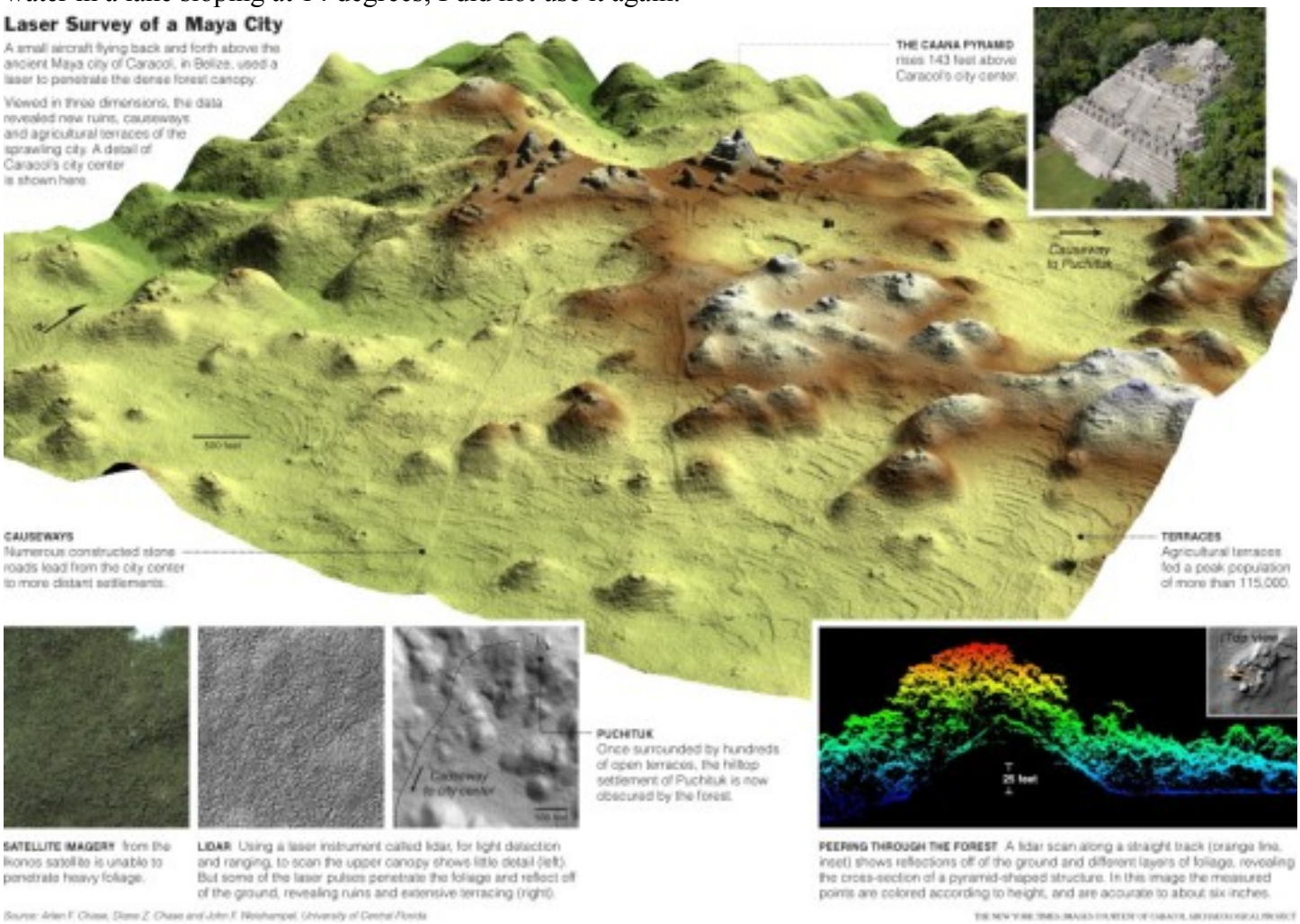
Dr. Weishampel arranged for the primary financing of the project from the little-known space archaeology program of the National Aeronautics and Space Administration. The flights were conducted by the National Science Foundation’s National Center for Airborne Laser Mapping, operated by the University of Florida and the University of California, Berkeley.

Other archaeologists, who were not involved in the research but were familiar with the results, said the technology should be a boon to explorations, especially ones in the tropics, with its heavily overgrown vegetation, including pre-Columbian sites throughout Mexico and Central America. But they emphasized that it would not obviate the need to follow up with traditional mapping to establish “ground truth.”

Jeremy A. Sabloff, a former director of the University of Pennsylvania Museum of Archaeology and Anthropology and now president of the Santa Fe Institute in New Mexico, said he wished he had had lidar when he was working in the Maya ruins at Sayil, in Mexico.

The new laser technology, Dr. Sabloff said, “would definitely have speeded up our mapping, given us more details and would have enabled us to refine our research questions and hypotheses much earlier in our field program than was possible in the 1980s.”

At first, Payson D. Sheets, a University of Colorado archaeologist, was not impressed with lidar. A NASA aircraft tested the laser system over his research area in Costa Rica, he said, “but when I saw it recorded the water in a lake sloping at 14 degrees, I did not use it again.”



Now, after examining the imagery from Caracol, Dr. Sheets said he planned to try lidar, with its improved technology, again. “I was stunned by the crisp precision and fine-grained resolution,” he said.

“Finally, we have a nondestructive and rapid means of documenting the present ground surface through heavy vegetation cover,” Dr. Sheets said, adding, “One can easily imagine, given the Caracol success, how important this would be in Southeast Asia, with the Khmer civilization at places like Angkor Wat.”

In recent reports at meetings of Mayanists and in interviews, the Chases noted that previous remote-sensing techniques focused more on the discovery of archaeological sites than on the detailed imaging of on-ground remains. The sensors could not see through much of the forest to resolve just how big the ancient cities had been. As a consequence, archaeologists may have underestimated the scope of Mayan accomplishments.

For the Caracol survey, the aircraft flew less than a half-mile above the terrain at the end of the dry season, when foliage is less dense. The Airborne Laser Terrain Mapper, as the specific advanced system is named, issued steady light pulses along 62 north-south flight lines and 60 east-west lines. This reached to what appeared to be the fringes of the city’s outer suburbs and most agricultural terraces, showing that the urban expanse encompassed at least 70 square miles.

Not all the laser pulses transmitted from the aircraft made it to the surface. Some were reflected by the tops of trees. But enough reached the ground and were reflected back to the airborne instruments. These signals, measured and triangulated by GPS receivers and processed by computers, produced images of the surface contours. This revealed distinct patterns of building ruins, causeways and other human modifications of the landscape.

The years the Chases spent on traditional explorations at Caracol laid the foundation for confirming the effectiveness of the laser technology. Details in the new images clearly matched their maps of known structures and cultural features, the archaeologists said. When the teams returned to the field, they used the laser images to find several causeways, terraced fields and many ruins they had overlooked.

The Chases said the new research demonstrates how a large, sustainable agricultural society could thrive in a tropical environment and thus account for the robust Maya civilization in its classic period from A.D. 250 to 900. “This will revolutionize the way we do settlement studies of the Maya,” Dr. Arlen Chase said on returning from this spring’s research at Caracol.

Lidar is not expected to have universal application. Dr. Sheets said that, for example, it would not be useful at his pre-Columbian site at Cerén, in El Salvador. The ancient village and what were its surrounding manioc fields are buried under many feet of volcanic ash, beyond laser detection.

Other modern technologies, including radar and satellite imaging, are already proving effective in the land beyond the temples at Angkor, in Cambodia, and in surveys of the Nile delta and ancient irrigation systems in Iraq.

Laser signals breaking through jungle cover are only the newest form of remote sensing in the pursuit of knowledge of past cultures, which began in earnest about a century ago with the advent of aerial photography. Charles Lindbergh drew attention to its application in archaeology with picture-taking flights over unexplored Pueblo cliff dwellings in the American Southwest.

NASA recently stepped up its promotion of technologies developed for broad surveys of Earth and other planets to be used in archaeological research. Starting with a few preliminary tests over the years, the agency has now established a formal program for financing archaeological remote-sensing projects by air and space.

“We’re not looking for monoliths on the Moon,” joked Craig Dobson, manager of the NASA space archaeology program. Every two years, Dr. Dobson said, NASA issues several three-year grants for the use of remote sensing at ancient sites. In addition to the Caracol tests, the program is supporting two other Maya research efforts, surveys of settlement patterns in North Africa and Mexico and reconnaissance of ancient ruins in the Mekong River Valley and around Angkor Wat.

Nothing like a latter-day Apollo project, of course, but the archaeology program is growing, Dr. Dobson said, and will soon double in size, to an annual budget of $1 million.

Nanotube transistor will help us bond with machines

* 14:10 12 May 2010 **by Colin Barras**

A novel transistor controlled by the chemical that provides the energy for our cells' metabolism could be a big step towards making prosthetic devices that can be wired directly into the nervous system.

Transistors are the fundamental building blocks of electronic gadgets, so finding ways to control them with biological signals could provide a route towards integrating electronics with the body.

Aleksandr Noy at the Lawrence Livermore National Laboratory in California and colleagues chose to control their transistor with adenosine triphosphate (ATP) – the molecular fuel found in nearly all living cells.

The new transistor is made up of a carbon nanotube, which behaves as a semiconductor, bridging the gap between two metal electrodes and coated with an insulating polymer layer that leaves the middle section of the

nanotube exposed. The entire device is then coated again, this time with a lipid bi-layer similar to those that form the membranes surrounding our body's cells.

Pumping ion

The team then applied a voltage across the transistor's electrodes and poured a solution containing ATP and potassium and sodium ions onto the device. This caused a current to flow through the electrodes – and the higher the concentration of ATP was, the more strongly current flowed.

The device responds in this way because the lipid bi-layer incorporates a protein that, when exposed to ATP, acts as an ion pump, shuttling sodium and potassium ions across the membrane.

"The ion pump protein is an absolutely critical element of this device," says Noy. "Each cycle, it hydrolyses an ATP molecule and moves three sodium ions in one direction and two potassium ions in the opposite direction." This results in the net pumping of one charge across the membrane to the nanotube.

The build-up of ions creates an electric field around the exposed portion of the semiconducting nanotube, increasing its conductivity in proportion to the strength of the field. When the supply of ATP is reduced, ions leak back across the membrane and the flow of current through the transistor falls.

Bioelectronic interfaces

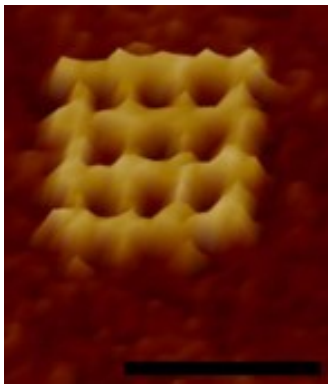
Noy claims that this is the first example of a truly integrated bioelectronic system. "I hope that this type of technology could be used to construct seamless bioelectronic interfaces to allow better communication between living organisms and machines."

Itamar Willner at the Hebrew University of Jerusalem in Israel thinks the technology is full of promise. "The beauty of the system is reflected by the fact that mechanical energy at the nanoscale [from the movement of ions] is transformed into electricity." He suggests it could be used to develop sensors to monitor intracellular metabolism. *Journal reference: Nano Letters, DOI: 10.1021/nl100499x*

DNA could be backbone of next generation logic chips

DURHAM, N.C. – In a single day, a solitary grad student at a lab bench can produce more simple logic circuits than the world's entire output of silicon chips in a month. So says a Duke University engineer, who believes that the next generation of these logic circuits at the heart of computers will be produced inexpensively in almost limitless quantities. The secret is that instead of silicon chips serving as the platform for electric circuits, computer engineers will take advantage of the unique properties of DNA, that double-helix carrier of all life's information.

In his latest set of experiments, Chris Dwyer, assistant professor of electrical and computer engineering at Duke's Pratt School of Engineering, demonstrated that by simply mixing customized snippets of DNA and other molecules, he could create literally billions of identical, tiny, waffle-looking structures.



This is a closeup of a waffle. **Chris Dwyer**

Dwyer has shown that these nanostructures will efficiently self-assemble, and when different light-sensitive molecules are added to the mixture, the waffles exhibit unique and "programmable" properties that can be readily tapped. Using light to excite these molecules, known as chromophores, he can create simple logic gates, or switches. These nanostructures can then be used as the building blocks for a variety of applications, ranging from the biomedical to the computational.

"When light is shined on the chromophores, they absorb it, exciting the electrons," Dwyer said. "The energy released passes to a different type of chromophore nearby that absorbs the energy and then emits light of a different wavelength. That difference means this output light can be easily differentiated from the input light, using a detector."

Instead of conventional circuits using electrical current to rapidly switch between zeros or ones, or to yes and no, light can be used to stimulate similar responses from the DNA-based switches – and much faster.

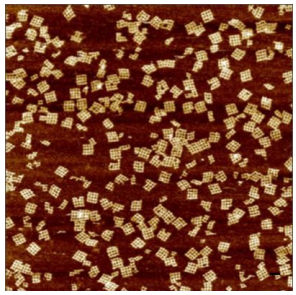
"This is the first demonstration of such an active and rapid processing and sensing capacity at the molecular level," Dwyer said. The results of his experiments were published online in the journal Small. "Conventional technology has reached its physical limits. The ability to cheaply produce virtually unlimited supplies of these tiny circuits seems to me to be the next logical step."

DNA is a well-understood molecule made up of pairs of complimentary nucleotide bases that have an affinity for each other. Customized snippets of DNA can cheaply be synthesized by putting the pairs in any order. In their experiments, the researchers took advantage of DNA's natural ability to latch onto corresponding and specific areas of other DNA snippets.

Dwyer used a jigsaw puzzle analogy to describe the process of what happens when all the waffle ingredients are mixed together in a container.

"It's like taking pieces of a puzzle, throwing them in a box and as you shake the box, the pieces gradually find their neighbors to form the puzzle," he said. "What we did was to take billions of these puzzle pieces, throwing them together, to form billions of copies of the same puzzle."

In the current experiments, the waffle puzzle had 16 pieces, with the chromophores located atop the waffle's ridges. More complex circuits can be created by building structures composed of many of these small components, or by building larger waffles. The possibilities are limitless, Dwyer said.



These are waffles. **Chris Dwyer**

In addition to their use in computing, Dwyer said that since these nanostructures are basically sensors, many biomedical applications are possible. Tiny nanostructures could be built that could respond to different proteins that are markers for disease in a single drop of blood.

Dwyer's research is supported by the National Science Foundation, the Air Force Research Laboratory, the Defense Advanced Research Projects Agency and the Army Research Office. Other members of the Duke team were Constantin Pistol, Vincent Mao, Viresh Thusu and Alvin Lebeck.

Maiden voyage for first true space sail

* 12 May 2010 **by Rachel Courtland**

ICARUS'S wings melted when he flew too close to the sun. Here's hoping a similar fate doesn't befall his namesake, the solar sail due to be unfurled by Japan's aerospace exploration agency (JAXA) next week. If all goes to plan, it will be the first spacecraft fully propelled by sunlight.

Solar sails like IKAROS, short for Interplanetary Kite-craft Accelerated by Radiation Of the Sun, aim to move forward by harnessing the momentum of photons colliding with it. The idea may be decades old, but solar sails have remained largely untested. Several sails have been unfurled in space to test deployment, and spacecraft like NASA's Mercury probe, Messenger, have used the pressure of sunlight to alter trajectories. But no spacecraft has used a sail as its primary means of propulsion.

Made of polyimide resin, IKAROS's sail measures 20 metres from corner to corner, but is just 0.0075 millimetres thick. To survive the launch and the trip into space, the gossamer sail will be folded accordion-style, then wrapped around the centre of the spacecraft.

To unfurl its sail, IKAROS will spin some 25 times per minute. The spacecraft's rotation will be used to extend four "arms" of folded material, and the rest of the sail will follow (see diagram). On 18 May, an H-IIA rocket will carry IKAROS into space along with its main payload, Japan's new Venus orbiter (see "Venus orbiter to fly close to super-rotating wind").

By piggybacking on the Venus launch, IKAROS will be able to get out of Earth orbit, where testing should be relatively simple. Solar sails that are tested in Earth's orbit must adjust their orientation with the sun regularly to build energy, says Bruce Betts of The Planetary Society in Pasadena, California, which hopes to launch its own sail, LightSail-1, into orbit as early as next year, paving the way for an eventual interplanetary mission. "They're doing it the way we would like to do it," Betts says. "Interplanetary space is what solar sails are really designed for."

IKAROS's trip will probably last six months at the longest, says JAXA's Junichiro Kawaguchi. But it could pave the way for more missions. The spacecraft will carry thin-film solar cells on its sail to show that it can also generate power. If all goes well, the demonstration could lead to a "hybrid", sun-driven mission to Jupiter.

Ancient DNA set to rewrite human history

Discovery that some humans are part-Neanderthal reveals the promise of comparing genomes old and new.

Rex Dalton

The worlds of ancient and modern DNA exploration have collided in spectacular fashion in the past few months. Last week saw the publication of a long-awaited draft genome of the Neanderthal, an archaic hominin from about 40,000 years ago1. Just three months earlier, researchers in Denmark reported the genome of a 4,000-year-old Saqqaq Palaeo-Eskimo2 that was plucked from the Greenland permafrost and sequenced in China using the latest technology.

As researchers compare these ancient genomes with the ever-expanding number from today's humans, they expect to gain insights into human evolution and migration - with more discoveries to come as they decipher DNA from other branches of the human evolutionary tree. "For the first time, ancient and modern genetic research is going hand in hand," says Eske Willerslev, whose team at the University of Copenhagen led the Palaeo-Eskimo sequencing project. "It is really a fantastic time."

Already, analysis of the Neanderthal genome has helped to resolve a debate about whether there was interbreeding between Neanderthals and Homo sapiens: genome comparisons suggest that the two groups mated an estimated 45,000–80,000 years ago in the eastern Mediterranean area. The sequencing study, from a consortium led by Svante Pääbo of the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, found that the genomes of non- African H. sapiens today contain around 1–4% of sequence inherited from Neanderthals.

The breakthroughs have been driven by the plummeting cost of sequencing, together with new strategies for reducing or detecting contamination by near-identical modern human DNA. These days, labs such as Pääbo's and Willerslev's might piece together a complete genome from the degraded scraps of DNA present in ancient bone, hair or teeth in as little as a month. Researchers from geneticists to fossil specialists can't wait for more.

Some hope to use ancient–modern genome comparisons to chart splits in human populations and how they might have correlated with climatic changes. "I call this molecular stratigraphy," says Jeffrey Long, a genetic anthropologist at the University of New Mexico in Albuquerque. "I then want to use this relative chronology of genetic events to compare to the palaeoclimate of Earth's biomes."

For Willerslev, ancient genomes offer the opportunity to trace prehistoric migration routes. By comparing the ancient Saqqaq genome with those of modern human populations, Willerslev and his team linked it to the present-day Chukchi people of Siberia, revealing that ancestors of this group trekked from eastern Siberia to Greenland about 5,500 years ago. "The genomes will allow us to test theories about peoples and migrations debated for a century," says Willerslev. "In the next five years, we will see a whole spectrum of discoveries." For example, the work could reveal whether the first Native Americans included migrants from Europe who crossed the ice-age Atlantic Ocean.

Pääbo and his team had nearly completed the Neanderthal genome by early 2009, about four years after the sequencing effort began. But, to carry out their analysis, the researchers raced to sequence five genomes of people from diverse modern populations in Europe, Asia and Africa. By comparing these to the Neanderthal genome, they found 78 protein-altering sequence changes that seem to have arisen since the divergence from Neanderthals several hundred thousand years ago, plus a handful of other genomic regions that show signs of positive selection in modern humans. These are linked to sperm motility, wound healing, skin function, genetic transcription control and cognitive development. The team also found that only the modern African genomes lacked segments of Neanderthal ancestry, indicating that interbreeding between the two groups probably occurred after humans migrated out of Africa.

That revelation is likely to revive the debate about whether or not the two groups are separate species, says anthropologist Fred Smith of Illinois State University in Normal, who has studied Neanderthals in Europe. Smith thinks that they are a subspecies of H. sapiens. Now that the genomes can be compared, it will be possible to investigate the genetic roots of some shared features. For instance, he points to the development of the occipital bun, a bulge at the back of the skull that is found in Neanderthals and in some modern humans. "We need to look and clarify certain characteristics in Neanderthal morphology with genetics," he says.

Most researchers in the field anticipate that the next ancient human genome will be completed by Pääbo's group, from a tiny finger bone found in a cave in the Altai Mountains in southern Siberia. In March, the group reported the mitochondrial DNA sequence from this individual3, an unknown hominin that, so far, does not genetically match either Neanderthals or H. sapiens and may represent a new species. The team dated the bone to about 40,000 years ago, but others say that the sediments around the bone may be as old as 100,000 years. There is speculation that the bone could be the remains of an older species of Homo, perhaps even of a remnant population of Homo heidelbergensis, known in Europe from 300,000 to 500,000 years ago, or of Homo erectus, found as early as 1.8 million years ago from Africa to Indonesia. A full sequence may help to resolve this.

Obtaining the genome of a human ancestor this old was previously unimaginable. "I honestly believe this new era will change our view of human evolution," Willerslev says.

References *1. Green, R. E. et al. Science 328, 710-722 (2010).*
2. Rasmussen, M. et al. Nature 463, 757-762 (2010). 3. Krause, J. et al. Nature 464, 894-897 (2010).

Of microorganisms and man

First large-scale formal quantitative test confirms Darwin's theory of universal common ancestry

Waltham, MA - More than 150 years ago, Darwin proposed the theory of universal common ancestry (UCA), linking all forms of life by a shared genetic heritage from single-celled microorganisms to humans. Until now, the theory that makes ladybugs, oak trees, champagne yeast and humans distant relatives has remained beyond the scope of a formal test. This week, a Brandeis biochemist reports in Nature the results of the first large scale, quantitative test of the famous theory that underpins modern evolutionary biology.

The results of the study confirm that Darwin had it right all along. In his 1859 book, On the Origin of Species, the British naturalist proposed that, "all the organic beings which have ever lived on this earth have descended from some one primordial form." Over the last century and a half, qualitative evidence for this theory has steadily grown, in the numerous, surprising transitional forms found in the fossil record, for example, and in the identification of sweeping fundamental biological similarities at the molecular level.

Still, rumblings among some evolutionary biologists have recently emerged questioning whether the evolutionary relationships among living organisms are best described by a single "family tree" or rather by multiple, interconnected trees - a "web of life." Recent molecular evidence indicates that primordial life may have undergone rampant horizontal gene transfer, which occurs frequently today when single-celled organisms swap genes using mechanisms other than usual organismal reproduction. In that case, some scientists argue, early evolutionary relationships were web-like, making it possible that life sprang up independently from many ancestors.

According to biochemist Douglas Theobald, it doesn't really matter. "Let's say life originated independently multiple times, which UCA allows is possible," said Theobald. "If so, the theory holds that a bottleneck occurred in evolution, with descendants of only one of the independent origins surviving until the present. Alternatively, separate populations could have merged, by exchanging enough genes over time to become a single species that eventually was ancestral to us all. Either way, all of life would still be genetically related."

Harnessing powerful computational tools and applying Bayesian statistics, Theobald found that the evidence overwhelmingly supports UCA, regardless of horizontal gene transfer or multiple origins of life. Theobald said UCA is millions of times more probable than any theory of multiple independent ancestries.

"There have been major advances in biology over the last decade, with our ability to test Darwin's theory in a way never before possible," said Theobald. "The number of genetic sequences of individual organisms doubles every three years, and our computational power is much stronger now than it was even a few years ago."

While other scientists have previously examined common ancestry more narrowly, for example, among only vertebrates, Theobald is the first to formally test Darwin's theory across all three domains of life. The three domains include diverse life forms such as the Eukarya (organisms, including humans, yeast, and plants, whose cells have a DNA-containing nucleus) as well as Bacteria and Archaea (two distinct groups of unicellular microorganisms whose DNA floats around in the cell instead of in a nucleus).

Theobald studied a set of 23 universally conserved, essential proteins found in all known organisms. He chose to study four representative organisms from each of the three domains of life. For example, he researched the genetic links found among these proteins in archaeal microorganisms that produce marsh gas and methane in cows and the human gut; in fruit flies, humans, round worms, and baker's yeast; and in bacteria like E. coli and the pathogen that causes tuberculosis.

Theobald's study rests on several simple assumptions about how the diversity of modern proteins arose. First, he assumed that genetic copies of a protein can be multiplied during reproduction, such as when one parent gives a copy of one of their genes to several of their children. Second, he assumed that a process of replication and mutation over the eons may modify these proteins from their ancestral versions. These two factors, then, should have created the differences in the modern versions of these proteins we see throughout life today. Lastly, he assumed that genetic changes in one species don't affect mutations in another species - for example, genetic mutations in kangaroos don't affect those in humans.

What Theobald did not assume, however, was how far back these processes go in linking organisms genealogically. It is clear, say, that these processes are able to link the shared proteins found in all humans to each other genetically. But do the processes in these assumptions link humans to other animals? Do these processes link animals to other eukaryotes? Do these processes link eukaryotes to the other domains of life, bacteria and archaea? The answer to each of these questions turns out to be a resounding yes.

Just what did this universal common ancestor look like and where did it live? Theobald's study doesn't answer this question. Nevertheless, he speculated, "to us, it would most likely look like some sort of froth, perhaps living at the edge of the ocean, or deep in the ocean on a geothermal vent. At the molecular level, I'm sure it would have looked as complex and beautiful as modern life."

Easter Island discovery sends archaeologists back to drawing board

Archaeologists have disproved the 50-year-old theory underpinning our understanding of how the famous stone statues were moved around Easter Island

Archaeologists have disproved the fifty-year-old theory underpinning our understanding of how the famous stone statues were moved around Easter Island. Fieldwork led by researchers at University College London and The University of Manchester, has shown the remote Pacific island's ancient road system was primarily ceremonial and not solely built for transportation of the figures.

A complex network of roads up to 800-years-old crisscross the Island between the hat and statue quarries and the coastal areas. Laying alongside the roads are dozens of the statues- or moai.

The find will create controversy among the many archaeologists who have dedicated years to finding out exactly how the moai were moved, ever since Norwegian adventurer Thor Heyerdahl first published his theory in 1958. Heyerdahl and subsequent researchers believed that statues he found lying on their backs and faces near the roads were abandoned during transportation by the ancient Polynesians.

But his theory has been completely rejected by the team led by Manchester's Dr Colin Richards and UCL's Dr Sue Hamilton.

Instead, their discovery of stone platforms associated with each fallen moai - using specialist 'geophysical survey' equipment – finally confirms a little known 1914 theory of British archaeologist Katherine Routledge that the routes were primarily ceremonial avenues.

The statues, say the Manchester and UCL team just back from the island, merely toppled from the platforms with the passage of time.

"The truth of the matter is, we will never know how the statues were moved," said Dr Richards.

"Ever since Heyerdahl, archeologists have come up with all manner of theories – based on an underlying assumption that the roads were used for transportation of the moai, from the quarry at the volcanic cone Rano Raraku. "What we do now know is that the roads had a ceremonial function to underline their religious and cultural importance.

"They lead – from different parts of the island – to the Rano Raraku volcano where the Moai were quarried.

"Volcano cones were considered as points of entry to the underworld and mythical origin land Hawaiki.

"Hence, Rano Ranaku was not just a quarry but a sacred centre of the island."

The previous excavation found that the roads are concave in shape –making it difficult to move heavy objects along them. And as the roads approach Rano Raraku, the statues become more frequent – which the team say, indicated an increasing grades of holiness.

"All the evidence strongly shows that these roads were ceremonial - which backs the work of Katherine Routledge from almost 100 years ago, " said Dr Sue Hamilton. "It all makes sense: the moai face the people walking towards the volcano. The statues are more frequent the closer they are to the volcano – which has to be way of signifying the increasing levels of importance."

She added: "What is shocking is that Heyerdahl actually found some evidence to suggest there were indeed platforms. "But like many other archaeologists, he was so swayed by his cast iron belief that the roads were for transportation – he completely ignored them."

NOTES FOR EDITORS *Routledge and her husband arrived at Easter Island in 1914, to publish her findings in a popular travel book, The Mystery of Easter Island in 1919.*

Doubt Is Cast on Many Reports of Food Allergies

By GINA KOLATA

Many who think they have food allergies actually do not.

A new report, commissioned by the federal government, finds the field is rife with poorly done studies, misdiagnoses and tests that can give misleading results.

While there is no doubt that people can be allergic to certain foods, with reproducible responses ranging from a rash to a severe life-threatening reaction, the true incidence of food allergies is only about 8 percent for children and less than 5 percent for adults, said Dr. Marc Riedl, an author of the new paper and an allergist and immunologist at the University of California, Los Angeles.

Yet about 30 percent of the population believe they have food allergies. And, Dr. Riedl said, about half the patients coming to his clinic because they had been told they had a food allergy did not really have one.

Dr. Riedl does not dismiss the seriousness of some people's responses to foods. But, he says, "That accounts for a small percentage of what people term 'food allergies.' "

Even people who had food allergies as children may not have them as adults. People often shed allergies, though no one knows why. And sometimes people develop food allergies as adults, again for unknown reasons. For their report, Dr. Riedl and his colleagues reviewed all the papers they could find on food allergies published between January 1988 and September 2009 - more than 12,000 articles. In the end, only 72 met their criteria, which included having sufficient data for analysis and using more rigorous tests for allergic responses.

"Everyone has a different definition" of a food allergy, said Dr. Jennifer J. Schneider Chafen of the Department of Veterans Affairs' Palo Alto Health Care System in California and Stanford's Center for Center for Primary Care and Outcomes Research, who was the lead author of the new report. People who receive a diagnosis after one of the two tests most often used - pricking the skin and injecting a tiny amount of the

suspect food and looking in blood for IgE antibodies, the type associated with allergies - have less than a 50 percent chance of actually having a food allergy, the investigators found.

One way to see such a reaction is with what is called a food challenge, giving people a suspect food disguised so they do not know if they are eating it or a placebo food. If the disguised food causes a reaction, the person has an allergy.

But in practice, most doctors are reluctant to use food challenges, Dr. Riedl said. They believe the test to be time consuming, and worry about asking people to consume a food, like peanuts, that can elicit a frightening response.

The paper, to be published Wednesday in The Journal of the American Medical Association, is part of a large project organized by the National Institute of Allergy and Infectious Diseases to try to impose order on the chaos of food allergy testing. An expert panel will provide guidelines defining food allergies and giving criteria to diagnose and manage patients. They hope to have a final draft by the end of June.

"We were approached as in a sense the honest broker who could get parties together to look at this question," said Dr. Matthew J. Fenton, who oversees the guidelines project for the allergy institute.

Authors of the new report - and experts on the guidelines panel - say even accepted dogma, like the idea that breast-fed babies have fewer allergies or that babies should not eat certain foods like eggs for the first year of life, have little evidence behind them.

Part of the confusion is over what is a food allergy and what is a food intolerance, Dr. Fenton said. Allergies involve the immune system, while intolerances generally do not. For example, a headache from sulfites in wine is not a food allergy. It is an intolerance. The same is true for lactose intolerance, caused by the lack of an enzyme needed to digest sugar in milk.

And other medical conditions can make people think they have food allergies, Dr. Fenton said. For example, people sometimes interpret acid reflux symptoms after eating a particular food as an allergy.

The chairman of the guidelines project, Dr. Joshua Boyce, an associate professor of medicine at Harvard and an allergist and pediatric pulmonologist, said one of the biggest misconceptions some doctors and patients have is that a positive test for IgE antibodies to a food means a person is allergic to that food. It is not necessarily so, he said.

During development, he said, the immune system tends to react to certain food proteins, producing IgE antibodies. But, Dr. Boyce said, "these antibodies can be transient and even inconsequential." "There are plenty of individuals with IgE antibodies to various foods who don't react to those foods at all," Dr. Boyce said.

The higher the levels of IgE antibodies to a particular food, the greater the likelihood the person will react in an allergic way. But even then, the antibodies do not necessarily portend a severe reaction, Dr. Boyce said. Antibodies to some foods, like peanuts, are much more likely to produce a reaction than ones to other foods, like wheat or corn or rice. No one understands why.

The guidelines panel hopes its report will lead to new research as well as clarify the definition and testing for food allergies. But for now, Dr. Fenton said, doctors should not use either the skin-prick test or the antibody test as the sole reason for thinking their patients have a food allergy.

"By themselves they are not sufficient," Dr. Fenton said.

Fossils resolve extinction puzzle

By Victoria Gill Science reporter, BBC News

Researchers have revealed remarkably well preserved fossils of soft-bodied marine creatures that are between 470 and 480 million years old.

Prior to this find, scientists were unsure whether such creatures died out in an extinction event during an earlier period known as the Cambrian.

The fossils were preserved in rocks formed by layers of ancient marine mud in south-eastern Morocco. They are described in the latest issue of the journal Nature.

The research team that studied the fossils described them as marine animals that lived during the early part of a period that followed the Cambrian, known as the Ordovician.

The fossils were preserved in brightly coloured minerals

Professor Derek Briggs from Yale University in New Haven, US, who was an author of the study, told BBC News that the discovery provided "a much more complete record of early marine life than we've ever had before". The creatures, he explained, closely matched those found in the Burgess Shale of British Columbia, a

locality in Yoho National Park, which is famous for yielding rare fossils of soft-bodied marine creatures from the Middle Cambrian period.

"There was an anomaly in the fossil record," said Dr Peter Van Roy, the lead researcher on the study, who is also based at Yale University. "Most of these animals just seemed to disappear at the end of the Middle Cambrian." The transition between the Cambrian and the Ordovician periods is crucial in evolutionary history.

The "Cambrian explosion" saw the sudden appearance of all the major animal groups. It was followed by the "great Ordovician biodiversification event" when the number of marine animal groups increased exponentially over a period of 25 million years.

Professor Briggs explained: "[These specimens have] shown that some of the organisms that we thought were exclusive to Cambrian actually persisted until the Ordovician."

Dr Jean-Bernard Caron, a palaeontologist from the Royal Ontario Museum in Canada who was not involved in this study, told BBC News that the discovery was "very exciting". He said that the fossil record had never before demonstrated that certain lineages of Cambrian animals survived until this later period.

Preserving life's record

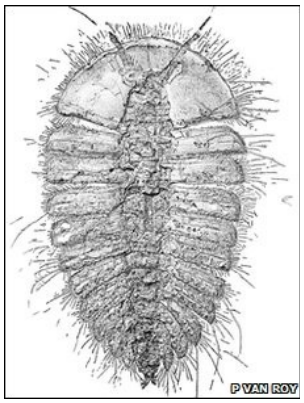
The specimens show that poor fossil preservation, rather than mass extinction, was probably responsible for this gap in the fossil record.

Because hard shells fossilise, and are therefore more readily preserved than soft tissue, scientists had an incomplete and biased view of the marine life that existed during the Ordovician.

But the conditions at this Moroccan site, Professor Briggs explained, were special.

"Very thick" marine muds, he said, were laid down in the deep ocean, trapping the creatures' bodies below the influence of storms.

These mud layers also excluded oxygen, creating conditions conducive to forming some of the minerals in which fossils are preserved.



Dr Van Roy created illustrations of the ancient marine creatures

Dr Van Roy, who has been working at this site in for around a decade, discovered this particular group of fossils just one year ago. But he expects to find even more and he and his team have planned further expeditions to Morocco. "We're only scratching the surface," he said. "I'm certain there will be more spectacular fossils coming out of this site in the near future."

The joke is on us: A new interpretation of bared teeth in archaeological artifacts

Bared teeth are a prominent and eye-catching feature on many historical and archaeological artifacts, and are commonly interpreted as representing death, aggression and the shamanic trance. But a study in the forthcoming issue of Current Anthropology argues that the bared-teeth motif often expresses something a bit less sinister: the smile.

Alice V. M. Samson, Faculty of Archaeology at Leiden University, the Netherlands, and Bridget M. Waller, Department of Psychology, University of Portsmouth, examined the bared-teeth motif (BTM) of the Taíno, who lived in the Greater Antilles (the Caribbean) from AD 1000 to the early decades of European contact (1492-1550). Here the BTM was used on bodily adornments and items associated with healing and shamanic practices, usually as part of decorations depicting human and animal faces.

Interpretations of the BTM by early European observers reflect a western religious and cultural worldview rather than an understanding of indigenous practices. Some of these interpretations stem from eyewitness accounts of the first European observers, who feared the indigenous people and their idols. They described the BTM as "diabolical and associated with ferocity or aggression or the expression of malevolent deities who need to be appeased." These interpretations have never been challenged and as a consequence, the bared-teeth motif has mostly been interpreted negatively.

However, Samson and Waller argue that the negative interpretation misses the mark. "Exposed and clenched teeth are not common features of the universal facial expression of anger, which is instead characterized by widened eyes, tensed lower eyelids, and lowered, furrowed brows," they write. "Studies of facial expression in human and non-human primates have shown that the bared-teeth expression is used in social contexts as an unambiguous signal of non-aggression, affiliation and benign intent."

The Greater Antilles were home to several different societies. Samson and Waller believe that pendants and other adornments that carried the BTM "acted as a sort of Taíno social grammar, allowing the indigenous peoples of the islands to engage with each other and facilitating interactions while retaining their differences."

Alice V. M. Samson and Bridget M. Waller, "Not Growling but Smiling: New Interpretations of the Bared-Teeth Motif in the Pre-Columbian Caribbean." Current Anthropology 51:3 (June 2010). For a PDF, email Courtney Cecale at courtneycecale@uchicago.edu.

Scripps Research study overturns decade-old findings in neurobiology

The new research suggests potential target for drugs to combat alcohol addiction

LA JOLLA, CA – In findings that should finally put to rest a decade of controversy in the field of neurobiology, a team at The Scripps Research Institute has found decisive evidence that a specific neurotransmitter system - the endocannabinoid system - is active in a brain region known to play a key role in the processing of memory, emotional reactions, and addiction formation. The new study also shows that this system can dampen the effects of alcohol, suggesting an avenue for the development of drugs to combat alcohol addiction.

The research was published in the journal Neuropsychopharmacology on May 12.

"This study will change a lot in the field," said Scripps Research Associate Professor Marisa Roberto, who was first author of the paper. "I'm confident it will have a big impact."

"This is very new," said Paul Schweitzer, associate professor of the neurobiology of addiction at Scripps Research and corresponding author of the paper. "It is the first time a study has shown a direct cellular interaction between endocannabinoids and alcohol in the brain."

The Missing Link?

The new research overturns the conclusions of a paper published by a European group in the Journal of Neuroscience in 2001. This paper claimed that endocannabinoid receptors, in particular the most common type called CB1, did not exist in the brain region called the central amygdala.

"Yet CB1 receptors are very abundant," said Schweitzer. "They are almost everywhere in the brain and there are lots of them. The endocannabinoid system acts on appetite, mood, memory - and addiction. Addiction is why we started to study it in the central amygdala."

The Scripps Research scientists began to suspect that the 2001 study, whose conclusions had been widely accepted in the field, might have missed the CB1 receptors in the brain's central amygdala. Indirect evidence from a number of subsequent studies - including one by Scripps Research Associate Professor Loren "Larry" Parsons - had suggested that the endocannabinoid system (and by implication its receptors) were indeed active in this brain region.

The Scripps Research team decided to take a fresh look at the whole question, and set out to conduct a new physiological study specifically looking for signs of the missing CB1 receptors in the central amygdala.

"There wasn't much physiology done before this," said Roberto. "There were a lot of behavioral studies, but very few on physiology and, aside from the 2001 study, none on the physiology in the central amygdala - this brain region that is so important for drugs of abuse."

Back on Track

Using electrophysiological techniques in brain slices to test the response of brain cells from the rat central amygdala, the scientists indeed found compelling evidence that CB1 receptors were active there.

The cells responded to a substance (agonist) mimicking the action of endocannabinoids in the brain. Up to a point, the more of the agonist the scientists applied, the bigger the effect. An inhibitor (antagonist) reversed this response. "We saw a big and consistent physiological effect," said Roberto. "It was beautiful. The receptor had to be there or otherwise it wouldn't have worked."

With this major milestone achieved, the researchers extended their investigation to their primary area of interest - the brain's response to alcohol. Alcohol abuse can lead to devastating consequences for individuals and families. It is also associated with direct and indirect public health costs estimated to be in the hundreds of billions of dollars yearly in the United States alone.

To learn more about the effect of alcohol on the biology of the brain, the scientists focused on the transmission of one particular neurotransmitter called gamma amino butyric acid (GABA). GABA is the main inhibitory neurotransmitter in the brain, and neurons in every brain region use GABA to fine-tune signaling throughout the nervous system. Previous studies by the Scripps Research scientists indicated that GABA plays a critical role in alcohol dependence and other addictions.

"We knew ethanol in these neurons increase GABA transmission, and that cannabinoids decrease GABA transmission," said Roberto. "So the question was what happens if we activate the cannabinoid system and we put ethanol on it."

When the scientists first applied the CB1 agonist on cells from the central amygdala, it decreased GABA transmission; when the scientists proceeded to put ethanol on top, the effect of ethanol was abolished. When the team reversed the order of application, GABA transmission first went up with the application of ethanol, then down with the application of the CB1 agonist.

"Alcohol and CB1 agonists have opposing effects on GABA," summarized Schweitzer. "Our feeling is that since the CB1 system is so widely expressed, there's a big role there in dampening the effect of alcohol."

While the team's research points to the endocannibinoid system as a potential target in the development of drugs to treat alcoholism, Schweitzer notes there are still many questions to be answered: Do CB1 agonists work the same way in brains that have become addicted to alcohol? What is the mechanism for this action? Can the effects of CB1 on alcohol metabolism be separated from its many other effects on mood, appetite, and memory?

Schweitzer also cautions against equating CB1 agonists and cannabis in interpreting the study's results. "This study does not have to do with marijuana, but the endocannabinoid system," he said. "On this level of analysis, the two don't have much in common."

In addition to Schweitzer and Roberto, authors of the paper, "The Endocannabinoid System Tonically Regulates Inhibitory Transmission and Depresses the Effect of Ethanol in Central Amygdala," include Maureen Cruz, Michal Bajo, George R. Siggins, and Loren H. Parsons of Scripps Research. See
http://www.nature.com/npp/journal/vaop/ncurrent/abs/npp201070a.html
The work was supported by National Institute on Alcohol Abuse and Alcoholism of the National Institutes of Health.

Cheese found to improve the immune response of the elderly

Cheese acting as 'carrier' for probiotic bacteria can help to restore immune system

Scientists in Finland have discovered that cheese can help preserve and enhance the immune system of the elderly by acting as a carrier for probiotic bacteria. The research, published in FEMS Immunology & Medical Microbiology, reveals that daily consumption of probiotic cheese helps to tackle age-related changes in the immune system.

"The increase in the proportion of aged individuals in modern society makes finding innovative ways to thwart the deterioration of the immune system a priority," said lead author Dr Fandi Ibrahim from the University of Turku in Finland. "The intake of probiotic bacteria has been reported to enhance the immune response through other products and now we have discovered that cheese can be a carrier of the same bacteria."

Dr Ibrahim's team believe that the daily intake of probiotic cheese can tackle the age-related deterioration of the immune system known as immunosenescene. This deterioration means the body is unable to kill tumour cells and reduces the immune response to vaccinations and infections. Infectious diseases, chronic inflammation disorders and cancer are hallmarks of Immunosenescene.

To tackle immunosenescene the team targeted the gastrointestinal tract, which is the main entry for bacteria cells into the body through food and drink and is also the site where 70% of vital immunoglobulin cells are created.

The team asked volunteers aged between 72 and 103, all of which lived in the same care home, to eat one slice of either placebo or probiotic Gouda cheese with their breakfast for four weeks. Blood tests where then carried out to discover the effect of probiotic bacteria contained within the cheese on the immune system.

The results revealed a clear enhancement of natural and acquired immunity through the activation of NK blood cells and an increase in phagocytic activity.

"The aim of our study was to see if specific probiotic bacteria in cheese would have immune enhancing effects on healthy older individuals in a nursing home setting," concluded Ibrahim. "We have demonstrated that the regular intake of probiotic cheese can help to boost the immune system and that including it in a regular diet may help to improve an elderly person's immune response to external challenges."

Sniff of local anesthetic in the dentist's chair could replace the needle

WASHINGTON - Modern dentistry has eliminated much of the "ouch!" from getting a shot of local anesthetic. Now a new discovery may replace the needle used to give local anesthetic in the dentist's chair for many procedures. Scientists are reporting evidence that a common local anesthetic, when administered to the nose as nose drops or a nasal spray, travels through the main nerve in the face and collects in high concentrations in the teeth, jaw, and structures of the mouth.

The discovery could lead to a new generation of intranasal drugs for noninvasive treatment for dental pain, migraine, and other conditions, the scientists suggest in American Chemical Society's bi-monthly journal Molecular Pharmaceutics. The article is scheduled for the journal's May-June issue.

William H. Frey II, Ph.D., and colleagues note that drugs administered to the nose travel along nerves and go directly to the brain. One of those nerves is the trigeminal nerve, which brings feelings to the face, nose and mouth. Until now, however, scientists never checked to see whether intranasal drugs passing along that nerve might reach the teeth, gums and other areas of the face and mouth to reduce pain sensations in the face and mouth.

Neil Johnson, working in the labs of Frey and Leah R. Hanson, Ph.D., at Regions Hospital in St. Paul, Minn., found that lidocaine or Xylocaine, sprayed into the noses of laboratory rats, quickly traveled down the trigeminal nerve and collected in their teeth, jaws, and mouths at levels 20 times higher than in the blood or

brain. The approach could provide a more effective and targeted method for treating dental pain/anxiety, trigeminal neuralgia (severe facial pain), migraine, and other conditions, the scientists say.

Furthermore, these scientists discovered an improved future location to administer anesthetic, the maxillary sinus. The maxillary sinus is a golfball-sized space located underneath each cheek where drug can be sprayed. Delivery into this confined space may be the next generation approach beyond a nasal spray in providing a more rapid and focused delivery of anesthetic.

"Trigeminal pathways deliver a low molecular weight drug from the nose to the brain and orofacial structures"

Rise in immigration may help explain drop in violent crimes, says CU-Boulder study

During the 1990s, immigration reached record highs and crime rates fell more precipitously than at any time in U.S. history. And cities with the largest increases in immigration between 1990 and 2000 experienced the largest decreases in rates of homicide and robbery, a University of Colorado at Boulder researcher has found.

Tim Wadsworth, an assistant professor of sociology, has tested the hypothesis, famously advanced by Harvard sociologist Robert J. Sampson, that the rise in immigration could be related to the drop in crime rates.

Wadsworth noticed Sampson's argument in a 2006 New York Times op-ed piece. As Wadsworth recalled, "My reaction was that this is really interesting, and it's a very testable question." New research supports Sampson's hypothesis, Wadsworth reports in the June edition of Social Science Quarterly.

"Cities that experienced greater growth in immigrant or new-immigrant populations between 1990 and 2000 tended to demonstrate sharper decreases in homicide and robbery," Wadsworth writes. "The suggestion that high levels of immigration may have been partially responsible for the drop in crime during the 1990s seems plausible."

Drawing from the FBI's Uniform Crime Reports and U.S. Census data, Wadsworth analyzed 459 cities with populations of at least 50,000. Wadsworth measured immigrant populations in two ways: those who are foreign-born and those who immigrated within the previous five years.

Wadsworth focused on medium and large cities because about 80 percent of violent crime takes place there. Wadsworth said distinguishing legal and illegal immigration is difficult, as the U.S. Census does not track those numbers, but he notes that immigrant citizens and non-citizens often live together in the same communities.

He tracked crime statistics for homicide and robbery because they tend to be reported more consistently than other crimes. Robberies are usually committed by strangers - which increases the reporting rate - and "homicides are difficult to hide," he said.

Wadsworth's findings contradict much of the public rhetoric about the relationship between immigration and crime. As the Arizona Republic reported this month, violent crime in that state's border towns has remained essentially flat during the past decade even as drug-trade violence on the other side of the border has burgeoned.

The presumed link between immigration and crime has a long history in the United States and overseas. Wadsworth said such sentiments are often expressed on Internet blogs and elsewhere. Wadsworth contends that looking at crime statistics at a single point in time can't explain the cause of crime rates. Using such snapshots in time, Wadsworth finds that cities with larger foreign-born and new-immigrant populations do have higher rates of violent crime. But many factors - including economic conditions - influence crime rates.

If higher rates of immigration were boosting crime rates, one would expect long-term studies to show crime rising and falling over time with the influx and exodus of immigrants. Instead, Wadsworth found the opposite.

Using long-term analyses, Wadsworth noted, cities that experienced the largest growth in the proportion of foreign-born and newly arrived immigrant populations experienced larger decreases in violent crime between 1990 and 2000. That finding, Wadsworth wrote, "suggests that Sampson may be right - that immigration may be partly responsible for the decrease in violent crime."

Wadsworth's research suggests that, controlling for a variety of other factors, growth in the new immigrant population was responsible, on average, for 9.3 percent of the decline in homicide rates, and that growth in total immigration was, on average, responsible for 22.2 percent of the decrease in robbery rates.

Exactly why growth in immigration is accompanying decreases in violent crime is hard to determine with city-level data. Some have suggested that immigrant communities are often characterized by extended family networks, lower levels of divorce, and cultural and religious beliefs that facilitate community integration. Wadsworth notes that "criminologists have long known that these factors provide buffers against crime."

"From the late 1800s to the present, the association between immigration and crime has been a center point of anti-immigrant discourse and public policy," Wadsworth writes. "Although there has been scant empirical research to support such claims, they have persisted with little debate."

Spitting cobras track first, predict later

Most venomous snakes are legendary for their lethal bites, but not all. Some spit defensively. Bruce Young, from the University of Massachusetts Lowell, explains that some cobras defend themselves by spraying debilitating venom into the eyes of an aggressor. Getting the chance to work with spitting cobras in South Africa, Young took the opportunity to record the venom spray tracks aimed at his eyes. Protected by a sheet of Perspex, Young caught the trails of venom and two things struck him: how accurately the snakes aimed and that each track was unique. This puzzled Young. For a start the cobra's fangs are fixed and they can't change the size of the venom orifice, 'so basic fluid dynamics would lead you to think that the pattern of the fluid should be fixed,' explains Young. But Young had also noticed that the snakes 'wiggled' their heads just before letting fly. 'The question became how do we reconcile those two things,' says Young, who publishes his discovery that the snakes initially track their victim's movement and then switch to predicting where the victim is going to be 200ms in the future in the Journal of Experimental Biology (http://jeb.biologists.org) on 14 May 2010.

Young remembers that Guido Westhoff had also noticed the spitting cobra's 'head wiggle', so he and his research assistant, Melissa Boetig, travelled to Horst Bleckmann's lab in the University of Bonn, Germany, to find out how spitting cobras fine-tune their venom spray. The team had to find out how a target provokes a cobra to spit, and Young was the man for that job, 'I just put on the goggles and the cobras start spitting all over,' laughs Young.

Wearing a visor fitted with accelerometers to track his own head movements while Boetig and Westhoff filmed the cobra's movements at 500 frames/s, Young stood in front of the animals and taunted them by weaving his head about. Over a period of 6 weeks, the team filmed over 100 spits before trying to discover why Young was so successful at provoking the snakes.

Analysing Young's movements, only one thing stood out; 200 ms before the snake spat, Young suddenly jerked his head. The team realised that Young's head jerk was the spitting trigger. They reasoned that the snake must be tracking Young's movements right up to the instant that he jerked his head and that it took a further 200 ms for the snake to react and fire off the venom.

But Young was still moving after triggering the snake into spitting and the snake can't steer the stream of venom, so how was the cobra able to successfully hit Young's eyes if it was aiming at a point where the target had been 200 ms previously? Realigning the data to the instant when Young jerked his head, the team compared all of the snakes' head movements and noticed that the cobras were all moving in a similar way. They accelerated their heads in the same direction that Young's eyes were moving. 'Not only does it speed up but it predicts where I am going to be and then it patterns its venom in that area,' explains Young.

So spitting cobras defend themselves by initially tracking an aggressor's movements. However, at the instant that an attacker triggers the cobra into spitting, the reptile switches to predicting where the attacker's eyes will be 200 ms in the future and aims there to be sure that it hits its target.

REFERENCE: *Westhoff, G., Boetig, M., Bleckmann, H. and Young, B. A. (2010). Target tracking during venom 'spitting' by cobras. J. Exp. Biol. 213, 1797-1802.*

Muscle mass in elderly boosted by combining resistance exercise and blood flow restriction

GALVESTON, Texas - For years, researchers have known that resistance exercise training –such as weightlifting, in which muscles work against gravity or another force - can be one of the most effective ways to fight the debilitating muscle loss caused by aging. But many older people are unable to get the full benefits of such training because they suffer from conditions such as arthritis that prevent them from lifting enough weight to stimulate muscle growth. And, while younger men and women continue to produce significant amounts of muscle protein for hours after a resistance exercise workout, seniors receive a much smaller post-workout benefit.

Now, though, University of Texas Medical Branch at Galveston researchers have determined that moderately and temporarily restricting the flow of blood through muscles - a practice adopted by bodybuilders who noticed that it made light weights feel heavier - can be combined with low-level resistance exercise training to produce muscle-mass increases in older men.

"We think that this may be a novel treatment for older people who need to bring their muscle mass back up," said UTMB physical therapy professor Blake Rasmussen, senior author of a paper on the investigation ("Blood flow restriction exercise stimulates mTORC1 signaling and muscle protein synthesis in older men") appearing in the May issue of the Journal of Applied Physiology. "It could also be used for patients who have had surgery and aren't capable of lifting enough weight to keep their muscles in shape, or for people who have arthritis or other conditions that make lifting heavy weights a problem."

The UTMB investigators studied changes in the thigh muscles of seven older men (average age 70) when they performed four minutes of low-resistance leg extension exercises both with and without inflatable cuffs that reduced blood flow out of the muscles. Muscle protein synthesis was measured in each of the men by monitoring changes in a chemical tracer infused into the bloodstream. In addition, a series of biopsies yielded muscle samples that were analyzed to track alterations in biochemical pathways critical to muscle growth.

"We saw that when we put the cuffs on, they responded similarly to young people doing traditional high-intensity resistance exercise," said UTMB graduate student Christopher Fry, the lead author of the paper. "The low-intensity exercise produced increases in protein synthesis, and activated two cellular pathways that stimulate protein synthesis and muscle growth in the post-exercise period."

Exactly how restricting blood flow in the muscles generated these effects remains unknown, although Rasmussen and Fry speculated that either an improved ability to activate Type II muscle fibers or a response to the sudden surge of blood into the muscles when the cuffs were released could be responsible. Whatever the mechanism, Rasmussen said, "we think it's an exciting potential new rehabilitation tool."

"You could use this following ACL knee surgery or hip fracture surgery, for example," Rasmussen said. "In the first few weeks after ACL surgery, the joint just won't allow you to lift heavy weight. So instead, you could use a really light weight with a restriction cuff, which may prevent the muscle loss that you normally see following knee surgery."

Other authors of the paper included graduate student Erin Glynn, assistant professor Micah Drummond, postdoctoral fellow Kyle Timmerman, research scientist Shaheen Dhanani and professor Elena Volpi, as well as Satoshi Fujita and Takashi Abe of the University of Tokyo. The National Institute of Arthritis and Musculoskeletal and Skin Diseases, UTMB's Institute for Translational Sciences Clinical Research Center, the UTMB Center for Rehabilitation Sciences and Sato Sports Plaza provided support for this research.

Early Feathers Too Weak for Flight

Poor flight ability suggests that early birds lived in trees and would launch themselves off branches in order to glide.

Content provided **by Randolph E. Schmid**, Associated Press

THE GIST

* ***Animals once thought to be the first fliers may only have been able to glide.***

* ***Analysis of recent fossil discoveries shows that their feathers were likely too weak for flapping flight.***

* ***It is unclear whether early birds had hollow feathers like their modern counterparts.***

This illustration is a reconstruction of the earliest known bird, Archaeopteryx. **Todd Marshall**

The early bird - didn't fly very well.

Recent fossil discoveries that showed feathers on some of the early flying animals, like the well-known Archaeopteryx, created a bit of a flap in the archaeological world. And now comes a report that those feathers may have been too weak for use in flapping flight - helpful only for gliding. Robert L. Nudds and Gareth J. Dyke report in Friday's edition of the journal Science that the central shaft of feathers on Archaeopteryx and Confuciusornis were much more slender than on feathers of similar-sized birds today.

Archaeopteryx flourished about 145 million years ago and Confuciusornis came along later, about 120 million years ago. Unfortunately, researchers cannot tell from the fossils if the feather shafts were hollow, like modern birds, or were solid. If their feathers were hollow the thin shafts would have buckled like a drinking straw if the animals had tried vigorous flapping, according to Nudds, of England's University of Manchester, and Dyke, of University College, Dublin, Ireland.

"If solid, the feathers would have snapped off," Nudds said. "Some thrust generation by these fossil birds cannot be discounted, but the vigorous flapping flight of modern birds is highly unlikely," the researchers concluded.

Nudds said poor flight ability suggests that the early birds lived in trees and would launch in order to glide to another tree. If they landed on the ground, they could clamber back up to gain height for their next glide.

"If Archaeopteryx and Confuciusornis were arboreal dwellers, which is suggested by my data, then it also suggests that avian flight originated in the trees and not on the ground," he said.

"Fossil wings that superficially resemble those of existing birds don't necessarily indicate flapping flight ability," concluded Nudds, who added that the origin of avian flapping flight is likely to be more recent than previously thought.

New Twist on Potential Malaria Drug Target Acts by Trapping Parasites in Cells

Boston, MA - Harvard School of Public Health (HSPH) researchers and colleagues seeking to block invasion of healthy red blood cells by malaria parasites have instead succeeded in locking the parasites within infected blood cells, potentially containing the disease.

The findings reveal an essential step in the biology of the most common and severe malaria parasite, Plasmodium falciparum, and offer a new drug target for fighting one of the world's most common and dangerous infections.

Malaria sickens up to one half billion people every year and kills up to one million, mostly children in sub-Saharan Africa. The high fevers, shaking chills, flu-like symptoms, and anemia can be fatal unless treated quickly. Malaria has grown resistant to a long list of drugs, and vaccines are still in experimental stages.

Working with the malaria parasite and human blood in test tubes and lab dishes, the research team identified a single fast-acting protein in the parasite that enables it and several dozen of its offspring to escape from a human red blood cell in preparation for quick invasion of many more healthy blood cells. Eliminating that protein traps the parasites in the cell.

After an infected mosquito bites a person, malaria parasites move into the liver, where they silently mature and multiply within weeks. Malaria parasites make people sick weeks or months later when they enter red blood cells and begin an exponential expansion. In a single cell, a parasite produces up to 32 offspring in about two days, which burst out to infect more red blood cells.

"This is the stage where things have to happen very fast for the parasite," said senior author Manoj Duraisingh, HSPH assistant professor of immunology and infectious diseases and senior author of the paper in the May 14 Science. "The parasite doesn't like to spend much time outside the cell. It grows and matures, and immediately following rupture, enters a new cell. It was a surprise that this protein kinase, which we thought would be involved in red blood cell invasion, turns out to be essential for the parasite getting out of the cell."

The study helps define the exit of the parasite from a blood cell as a highly choreographed process and distinguishes the egress and invasion steps, the researchers said.

"When the parasite gets out of the red blood cell, it has a matter of seconds or minutes to get into new red blood cells, or it will be cleared or killed by the human immune system," said first author Jeffrey Dvorin, a postdoctoral research fellow in the Duraisingh Lab at HSPH and a clinical fellow in pediatric infectious diseases at Children's Hospital Boston. "We found an important trigger for the parasite to exit cells that may be independent from the invasion trigger."

Even better, the protein is found in the parasite and in plants, but not in humans, which means a drug targeted to that protein may be less toxic for people. The protein belongs to a family of Plasmodium falciparum calcium-dependent protein kinases, or PfCDPK5 for short in this case. Other members of the family have been implicated in parasite egress of red blood cells, but this is the first study using a genetic technique to validate a protein critical for parasite egress of red blood cells, according to the researchers.

Many companies and labs are looking for inhibitors of parasite egress and invasion of red blood cells, but no anti-malarial drugs yet target these stages of the parasite lifecycle, Dvorin said.

The paper also demonstrates the usefulness of a new tool that can be used to evaluate additional members of the kinase family, as well as other signaling pathways that regulate key events in the blood stage of malaria infection. As of 2002, "we have a malaria genome of about 6,000 genes," said Duraisingh. "We need a means of prioritizing specific gene candidates for further drug development."

The method, first developed in a mammalian cell culture system by co-author Thomas Wandless of Stanford University, allows scientists to analyze the function of certain proteins and to identify other potential therapeutic targets in the malaria parasite, the researchers said.

As adapted for this study, Dvorin and his colleagues reverse-engineered candidate genes to make faulty proteins that would only survive in the presence of a stabilizing chemical. Without that constant protection, the protein is eliminated from the parasite.

"For 24 hours a day, 7 days a week, we grew the parasites in the presence of the stabilizing chemical," Dvorin said. "After the parasites invaded new red blood cells, we washed away the stabilizing drug. Even though the parasites seemed to develop just fine, they were unable to leave the red blood cell."

Interestingly, the team's work also produced an elusive scientific tool for their colleagues in the vaccine field: Mature invasive parasites. "One of the experiments in the paper mechanically releases the parasites, which have matured into virulent and invasive forms," Duraisingh said. "People have been trying to get viable parasites in this form for study. This is a great resource for vaccine studies."

"A Plant-Like Kinase in Plasmodium falciparum Regulates Parasite Egress From Erythrocytes," Science, May 14, 2010, J.D. Dvorin et. al.

This work was supported by Pediatric Scientist Development Program Fellowship awards, National Institutes of Health, Burroughs Wellcome Fund New Investigator in the Pathogenesis of Infectious Diseases Fellowship, the Medical Research Council UK, a Wellcome Trust Project grant, and an EU FP7 grant MALSIG.

Giant Plumes of Oil Found Forming Under Gulf of Mexico

By JUSTIN GILLIS

Scientists are finding enormous oil plumes in the deep waters of the Gulf of Mexico, including one as large as 10 miles long, 3 miles wide and 300 feet thick in spots. The discovery is fresh evidence that the leak from the broken undersea well could be substantially worse than estimates that the government and BP have given.

"There's a shocking amount of oil in the deep water, relative to what you see in the surface water," said Samantha Joye, a researcher at the University of Georgia who is involved in one of the first scientific missions to gather details about what is happening in the gulf. "There's a tremendous amount of oil in multiple layers, three or four or five layers deep in the water column."

The plumes are depleting the oxygen dissolved in the gulf, worrying scientists, who fear that the oxygen level could eventually fall so low as to kill off much of the sea life near the plumes.

Dr. Joye said the oxygen had already dropped 30 percent near some of the plumes in the month that the broken oil well had been flowing. "If you keep those kinds of rates up, you could draw the oxygen down to very low levels that are dangerous to animals in a couple of months," she said Saturday. "That is alarming."

The plumes were discovered by scientists from several universities working aboard the research vessel Pelican, which sailed from Cocodrie, La., on May 3 and has gathered extensive samples and information about the disaster in the gulf.

Scientists studying video of the gushing oil well have tentatively calculated that it could be flowing at a rate of 25,000 to 80,000 barrels of oil a day. The latter figure would be 3.4 million gallons a day. But the government, working from satellite images of the ocean surface, has calculated a flow rate of only 5,000 barrels a day.

BP has resisted entreaties from scientists that they be allowed to use sophisticated instruments at the ocean floor that would give a far more accurate picture of how much oil is really gushing from the well.

"The answer is no to that," a BP spokesman, Tom Mueller, said on Saturday. "We're not going to take any extra efforts now to calculate flow there at this point. It's not relevant to the response effort, and it might even detract from the response effort."

The undersea plumes may go a long way toward explaining the discrepancy between the flow estimates, suggesting that much of the oil emerging from the well could be lingering far below the sea surface.

The scientists on the Pelican mission, which is backed by the National Oceanic and Atmospheric Administration, the federal agency that monitors the health of the oceans, are not certain why that would be. They say they suspect the heavy use of chemical dispersants, which BP has injected into the stream of oil emerging from the well, may have broken the oil up into droplets too small to rise rapidly.

BP said Saturday at a briefing in Robert, La., that it had resumed undersea application of dispersants, after winning Environmental Protection Agency approval the day before.

"It appears that the application of the subsea dispersant is actually working," Doug Suttles, BP's chief operating officer for exploration and production, said Saturday. "The oil in the immediate vicinity of the well and the ships and rigs working in the area is diminished from previous observations."

Many scientists had hoped the dispersants would cause oil droplets to spread so widely that they would be less of a problem in any one place. If it turns out that is not happening, the strategy could come under greater scrutiny. Dispersants have never been used in an oil leak of this size a mile under the ocean, and their effects at such depth are largely unknown.

Much about the situation below the water is unclear, and the scientists stressed that their results were preliminary. After the April 20 explosion of the Deepwater Horizon, they altered a previously scheduled research mission to focus on the effects of the leak.

Interviewed on Saturday by satellite phone, one researcher aboard the Pelican, Vernon Asper of the University of Southern Mississippi, said the shallowest oil plume the group had detected was at about 2,300 feet, while the deepest was near the seafloor at about 4,200 feet.

"We're trying to map them, but it's a tedious process," Dr. Asper said. "Right now it looks like the oil is moving southwest, not all that rapidly."

He said they had taken water samples from areas that oil had not yet reached, and would compare those with later samples to judge the impact on the chemistry and biology of the ocean.

While they have detected the plumes and their effects with several types of instruments, the researchers are still not sure about their density, nor do they have a very good fix on the dimensions.

Given their size, the plumes cannot possibly be made of pure oil, but more likely consist of fine droplets of oil suspended in a far greater quantity of water, Dr. Joye said. She added that in places, at least, the plumes might be the consistency of a thin salad dressing.

Dr. Joye is serving as a coordinator of the mission from her laboratory in Athens, Ga. Researchers from the University of Mississippi and the University of Southern Mississippi are aboard the boat taking samples and running instruments.

Dr. Joye said the findings about declining oxygen levels were especially worrisome, since oxygen is so slow to move from the surface of the ocean to the bottom. She suspects that oil-eating bacteria are consuming the oxygen at a feverish clip as they work to break down the plumes.

While the oxygen depletion so far is not enough to kill off sea life, the possibility looms that oxygen levels could fall so low as to create large dead zones, especially at the seafloor. “That’s the big worry,” said Ray Highsmith, head of the Mississippi center that sponsored the mission, known as the National Institute for Undersea Science and Technology.

The Pelican mission is due to end Sunday, but the scientists are seeking federal support to resume it soon.

“This is a new type of event, and it’s critically important that we really understand it, because of the incredible number of oil platforms not only in the Gulf of Mexico but all over the world now,” Dr. Highsmith said. “We need to know what these events are like, and what their outcomes can be, and what can be done to deal with the next one.” *Shaila Dewan contributed reporting from Robert, La.*

When Will We Be Able to Build Brains Like Ours?

Sooner than you think - and the race has lately caused a 'catfight'

By Terry Sejnowski

When physicists puzzle out the workings of some new part of nature, that knowledge can be used to build devices that do amazing things - airplanes that fly, radios that reach millions of listeners. When we come to understand how brains function, we should become able to build amazing devices with cognitive abilities - such as cognitive cars that are better at driving than we are because they communicate with other cars and share knowledge on road conditions. In 2008, the National Academy of Engineering chose as one of its grand challenges to reverse-engineer the human brain. When will this happen? Some are predicting that the first wave of results will arrive within the decade, propelled by rapid advances in both brain science and computer science. This sounds astonishing, but it’s becoming increasingly plausible. So plausible, in fact, that the great race to reverse-engineer the brain is already triggering a dispute over historic “firsts.”

The backdrop for the debate is one of dramatic progress. Neuroscientists are disassembling brains into their component parts, down to the last molecule, and trying to understand how they work from the bottom up. Researchers are racing to work out the wiring diagrams of big brains, starting with mice, cats and eventually humans, a new field called connectomics. New techniques are making it possible to record from many neurons simultaneously, and to selectively stimulate or silence specific neurons. There is an excitement in the air and a sense that we are beginning to understand how the brain works at the circuit level. Brain modelers have so far been limited to modeling small networks with only a few thousand neurons, but this is rapidly changing.

Meanwhile, digital computers are increasing exponentially in processing power, memory storage and communications bandwidth. Up until recently, this was accomplished by accelerating the clock speed, which has leaped from kilohertz to gigahertz in my lifetime. But computer clocks have plateaued and now, advances in computing power are coming from increases in the number of processors and improved abilities to distribute a problem across them. The fastest supercomputers have hundreds of thousands of processors, and graphics processing units (GPUs) give desktop personal computers the same speed that supercomputers had ten years ago. If Moore’s Law of exponential growth in computing power does not break down first, at some point computers should become powerful enough, and our knowledge of the brain should be complete enough, to build devices based on the principles of neural computation. Like brains, these devices will be based on probabilistic rather than deterministic logic and will reason inductively rather than deductively.

Now, to the dispute, widely known as the “catfight.” Last November, IBM researcher Dharmendra Modha announced at a supercomputing conference that his team had written a program that simulated a cat brain. This news took many by surprise, since he had leapfrogged over the mouse brain and beaten other groups to this milestone. For this work, Modha won the prestigious ACM Gordon Bell prize, which is awarded to recognize outstanding achievement in high-performance computing applications.

However, his audacious claim was challenged by Henry Markram, a neuroscientist at the Ecole Polytechnique Fédérale de Lausanne and the leader of the Blue Brain project, who announced in 2009 that: "It is not impossible to build a human brain and we can do it in 10 years.". In an open letter to IBM Chief Technical Officer Bernard Meyerson, Markram accused Modha of “mass deception” and called his paper a

"hoax" and a "scam." This has become a cause célèbre in the blogosphere and remains a hot topic among those of us who inhabit the intersection of brain and computer science.

The crux of the dispute is: What does it mean to model the cat brain? Both groups are simulating a large number of model neurons and connections between them. Both models run much, much slower than real time. The neurons in Modha's model only have a soma - the cell body containing the cell nucleus - and simplified spikes. In contrast, Markram's model has detailed reconstructions of neurons, with complex systems of branching connections called dendrites and even a full range of gating and communication mechanisms such as ion channels. The synapses and connections between the neurons in Modha's model are simplified compared to the detailed biophysical synapses in Markram's model. These two models are at the extremes of simplicity and complex realism.

This controversy puts into perspective a tension between wanting to use simplified models of neurons, in order to run simulations faster, versus including the biological details of neurons in order to understand them. Looking at the same neuron, physicists and engineers tend to see the simplicity whereas biologists tend to see the complexity. The problem with simplified models is that they may be throwing away the baby with the bathwater. The problem with biophysical models is that the number of details is nearly infinite and much of it is unknown. How much brain function is lost by using simplified neurons and circuits? This is one of the questions we might be able to answer if we could get Modha and Markram to directly compare their models.

Unfortunately, the large-scale simulations from both groups at present resemble sleep rhythms or epilepsy far more closely than they resemble cat behavior, since neither has sensory inputs or motor outputs. They are also missing essential subcortical structures, – such as the cerebellum that organizes movements, the amygdala that creates emotional states and the spinal cord that runs the musculature. Nonetheless, from Modha's model we are learning how to program large-scale parallel architectures to perform simulations that scale up to the large numbers of neurons and synapses in real brains. From Markram's models, we are learning how to integrate many levels of detail into these models. In his paper, Modha predicts that the largest supercomputer will be able to simulate the basic elements of a human brain in real time by 2019, so apparently he and Markram agree on this date; however, at best these simulations will resemble a baby brain, or perhaps a psychotic one. There is much more to a human brain than the sum of its parts.

Of course, it may not be necessary or desirable to build a cat or a human brain, since we already have fully functional cats and humans. This technology could, however, enable other applications. In 2005, Simon Haykin, director of the Cognitive Systems Laboratory at McMaster University, wrote an influential article called "Cognitive radio: Brain-empowered wireless communications" which laid the groundwork for a new generation of wireless networks that use computational principles from brains to predictively model the use of the electromagnetic spectrum, and are more efficient at using the bandwidth than current standards. This is not pie in the sky. Plans to deploy early versions of these intelligent communications systems in the next federal auction of the electromagnetic spectrum were discussed at a recent meeting of the Council of Advisors on Science and Technology with President Obama.

Soon to come are similar ways to enhance other utilities, such as the "cognitive power grid," and other devices, such as the cognitive car. The sensorium and motorium of these cognitive systems will be the infrastructure of the world. Sensors will stream information - on the use of electricity, road conditions, weather patterns, the spread of diseases - and use this information to optimize goals, such as reducing power usage and travel time, by regulating the flow of resources. Parts of this system are already in place but there is as yet no central nervous system to integrate this torrent of information and take appropriate actions. Someday soon, it appears, there will be. And gradually, as it increasingly mimics the workings of our brains, the world around us will become smarter and more efficient. As this cognitive infrastructure evolves, it may someday even reach a point where it will rival our brains in power and sophistication. Intelligence will inherit the earth.