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Otto von Bismarck, Master Statesman

By HENRY A. KISSINGER
BISMARCK
A Life
By Jonathan Steinberg
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In the summer of 1862, Otto von Bismarck was appointed minister-president of Prussia. His highest previous rank had been ambassador to Russia. He had never held an administrative position. Yet with a few brusque strokes, the novice minister solved the riddle that had stymied European diplomacy for two generations: how to unify Germany and reorganize Central Europe. He had to overcome the obstacle that Germany comprised 39 sovereign states grouped in the so-called German Confederation. All the while, Central European trends were warily observed by the two "flanking" powers, France and Russia, ever uneasy about — and tempted to prevent — the emergence of a state capable of altering the existing European balance of power.

Within nine years, Bismarck untied this knot in what Jonathan Steinberg, a professor of history at the University of Pennsylvania, describes as "the greatest diplomatic and political achievement by any leader in the last two centuries." He overcame the princes of the German states in two wars and rallied them in a third; won over public opinion by granting universal manhood suffrage — making Prussia one of the first states in Europe to do so; paralyzed France by holding out the prospect of agreeing to the French acquisition of Luxembourg, and Russia by a benevolent attitude during the Polish revolution of 1863. Bismarck accomplished all this "without commanding a single soldier, without dominating a vast parliamentary majority, without the support of a mass movement, without any previous experience in government and in the face of national revulsion at his name and his reputation."

It is a measure of Steinberg's achievement in "Bismarck: A Life" that the subsequent description of the "political genius of a very unusual kind" becomes far from a panegyric. He describes — in an incisive, if occasionally distracting, psychological approach — a highly complex person who incarnated the duality that later tempted Germany into efforts beyond its capacity. Bismarck was never seen in public without a uniform, yet he had never really served in the military and was generally viewed with suspicion by the military leaders for what they saw as his excessive moderation. The man of "blood and iron" wrote prose of extraordinary directness and lucidity, comparable in distinctiveness to Churchill's use of the English language. The embodiment of realpolitik turned power into an instrument of self-restraint by the agility of his diplomacy. He dominated Germany and European diplomacy from a single power base, the confidence of an aging king, without other institutional backing or great personal following.

Bismarck is often cited as the quintessential realist, relying on power at the expense of ideals. He was, in fact, far more complicated. Power, to be useful, must be understood in its components, including its limits. By the

same token, ideals must be brought, at some point, into relationship with the circumstances the leader is seeking to affect. Ignoring that balance threatens policy with either veering toward belligerence from the advocates of power or toward crusades by the idealists.

Bismarck dominated because he understood a wider range of factors relevant to international affairs — some normally identified with power, others generally classified as ideals — than any of his contemporaries. He came into office in a world beset by the memory of the Napoleonic period. The new order that emerged was based on the belief that the goal of peace could be achieved only by nations with compatible domestic institutions (shades of modern neoconservatism). The Holy Alliance of Prussia, Austria and Russia was created to police the continuation of essentially legitimist conservative states, committed to upholding rule by their royal families. The balance of power sustained Europe's strategic equilibrium. When Bismarck became *Ministerpräsident*, all these elements were in flux. A new Napoleon had made himself emperor in France by popular election. Parliaments were gaining at the expense of princes. The principles of the Holy Alliance were in tatters.

Bismarck's originality consisted of being neither in the camp of power nor in that of ideology. During the Crimean War, while serving as ambassador to the German Confederation, Bismarck outlined three options for his king: (a) alliance with Russia, which implied a conservative orientation; (b) alliance with France, implying the opposite; or (c) a sharp shift to domestic policies in Prussia with an introduction of popular institutions — a step that would cut the ground out from under the princes. Like a physicist, Bismarck analyzed the principal elements of each situation and then used them in an overall design. He appealed to the czar on the principles of the Holy Alliance, to France on openness to liberal institutions, to German liberals with the prospect of a popular legislature. He fought three military campaigns, each with limited political objectives — intended to co-opt, rather than humiliate, the adversary. Under his leadership, Prussia was among the first on the continent not only to introduce universal suffrage but also, later on, to enact sweeping social legislation. He prevailed not so much because he was stronger as because his adversaries proved less nimble.

Bismarck's opponents were still wedded to the 18th-century concepts of the international system as a great clockwork with intricately meshed parts: the science of Newton. Bismarck foreshadowed an age whose equilibrium was an ever-changing interaction of forces, themselves in constant flux, like later atomic physics. Its appropriate philosopher was not Descartes but Darwin; not "I think, therefore I am," but the "survival of the fittest."

Cynicism by itself produces a shallow opportunism. Any serious policy requires a fixed point from which to alter the world. Bismarck's Archimedean point was the belief in the uniqueness of Prussian institutions. Because, as Bismarck pointed out, the Prussian king was secure even if his entire army was out of the country, Prussia could maneuver with extraordinary flexibility to establish its pre-eminence in Central Europe. Until Bismarck appeared on the scene, it had generally been assumed that nationalism and liberalism represented opposite poles; he rejected that proposition. Prussia's cohesion was sufficiently strong, he argued, that it could challenge the authority of monarchs abroad even while conducting a monarchist policy at home. Like Disraeli, he believed that a broadly based suffrage would be nationalistic and could be mobilized for conservative causes.

The result, however, sowed the seeds of Germany's 20th-century tragedies. Dominated as it was by what Steinberg calls "the sovereignty of an extraordinary, gigantic self," the new Germany lacked institutional balance. Too democratic for conservatives, too authoritarian for liberals, the new order, both domestic and foreign, was tailored to one personality who sought to restrain the contending forces by manipulating their antagonisms.

Still, for the 28 years that he served as chancellor of Germany, Bismarck preserved what he had built by a restrained and wise diplomacy, which was the single most important element in maintaining the peace of Europe. "My map of Africa lies in Europe," he said in resisting pressures to acquire colonies. And he responded to the suggestion of a pre-emptive war against Russia with: "Woe to the statesman whose arguments for entering a war are not as convincing at its end as they were at the beginning."

But "Bismarck: A Life" shows as well the nemesis of success. The emergence of a united Germany reduced the flexibility once provided by the multitude of sovereign states in the center of Europe. A united Germany was powerful enough to defeat each of its neighbors individually, almost obliging these neighbors, especially France and Russia, to explore a coalition. The nightmare of hostile coalitions (*le cauchemar des coalitions*), designed to compel Germany to divide its forces between East and West, grew into one of the motivating

forces of Bismarckian diplomacy. He sought to counter it by involving Germany in a dizzying series of partly overlapping, partly conflicting alliances with the aim of giving the other great powers — except the irreconcilable France — a greater interest to work with Germany than to coalesce against it.
It was not to be. Bismarck's triumphs of the 1860s restricted the maneuvering room for his intricate plan of an alliance with Austria; a Three Emperors' League with Austria and Russia; and a so-called reinsurance treaty with Russia. The annexation of Alsace-Lorraine in 1871 produced a France determined on revenge and, hence, a potential ally of any other adversary of Germany. Only five major states remained, constricting the available combinations. Even Bismarck, in his later years, had difficulty managing these arrangements between incompatible partners or keeping track of them, as Steinberg impressively shows.
The dynamism by which Bismarck reordered Central Europe was difficult to replicate when he sought to preserve what he had built. When he acted as a revolutionary as minister-president of Prussia, Bismarck could control the timing of policy. In his years as chancellor of Germany and as protector of what existed, others posed the challenges. Bismarck had to await events. In a sense, he became the prisoner of his own design and of its domestic necessities (to which, for example, he had to sacrifice his reluctance to enter the colonial race). Bismarck was dismissed by a new emperor in 1890. It was the ultimate paradox that the man who had dominated Europe by exalting stability should conclude his career at the whim of a young, somewhat unstable, sovereign.
Bismarck's successor, Caprivi, pointed out the essential weakness of the Bismarckian system by saying that while Bismarck had been able to keep five balls in the air simultaneously, he (Caprivi) had difficulty controlling two. Shortly after Bismarck's departure, the Russian treaty was abandoned. Shortly after that, France and Russia formed an alliance and Europe slid into rigid coalitions. Bismarck's rationalism made him believe that he could distill a doctrine of self-limitation from an analysis of the nuances of power relationships. But power is the most difficult component of policy to analyze. Because its nuances eluded Bismarck's successors and imitators, the application of his supposed lessons led to an armament race and World War I.
I must register two caveats. Steinberg's hostility toward Bismarck's personality sometimes causes him to overemphasize personal traits at the expense of his strategic concepts, which were usually quite brilliant. The second caveat concerns the direct line Steinberg draws from Bismarck to Hitler. Bismarck was a rationalist, Hitler a romantic nihilist. Bismarck's essence was his sense of limits and equilibrium; Hitler's was the absence of measure and rejection of restraint. The idea of conquering Europe would never have come to Bismarck; it was always part of Hitler's vision. Hitler could never have pronounced Bismarck's famous dictum that statesmanship consisted of listening carefully to the footsteps of God through history and walking with him a few steps of the way. Hitler left a vacuum. Bismarck left a state strong enough to overcome two catastrophic defeats as well as a legacy of unassimilable greatness. Nevertheless, "Bismarck: A Life" is the best study of its subject in the English language.
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http://www.nytimes.com/2011/04/03/books/review/book-review-bismarck-by-jonathan-steinberg.html?nl=books&emc=booksupdateema1

'A time of degradation and desolation'
Reclaiming the Veneto

A small group of Italians from Venice and Padua are trying to reclaim their cities, and their own souls, from contemporary incivility and corruption by taking to the water. But only in old wooden boats, and always unmotorised
by Ed Emery
When somebody mentioned Silvio Berlusconi's well-known romps at dinner recently, a friend of mine shouted "No! Stop!" My friend – he's Italian, a doctor – feels so ashamed of the presence of "this clown" in Italy's body politic that he refuses to talk about Berlusconi. Italy is in political stalemate: no credible leftwing opposition, no hope of a breakthrough, and then there's the clown.
We began instead to talk of canals, and the pleasures of gondoliering, which in Venice they call *voga veneta*. But there was no "instead". The water talk became a metaphor for the rot in Italian society. Last November the area between Padua and Vicenza was badly flooded, with loss of life and property. People had to rely on volunteers and charity support from neighbouring communities. Why did the flooding happen? The doctor explained bitterly that it was because of the degradation of civic structures. "In the old days, the power of the Venetian state was its canals and waterways. There was a special authority, the Magistrato alle Acque, responsible for their maintenance. It had draconian powers. If you dug an illegal well, or diverted waters from a canal, the penalty was death, because it was an act of treason against the state. I remember my grandparents living in fear of the annual waterways inspection."
Then came the 1950s. Padua foolishly filled in its canals and turned them into roads. The doctor described the poor state of the region's remaining waterways. The water magistracy had been abolished, its powers semi-privatised, the new bodies were starved of money, and the rot set in. The use of piles was abandoned, the banks collapsed, the waterways silted up, dykes were not maintained, and when the rains came the floods broke through.
So: you can run society like a television game show, but if you ignore the patient daily work of cure and care, then nature will take her revenge.
Radical riverist
I walked to some freshly dug earth at the foot of a fine brick-built Venetian bastion, just where the city of Padua fronts the river Piovego. An elderly gentleman in rubber boots was digging with the long-handled shovel known as a *badile*. He was Elio Franzin, a communist, and honorary president of a local boating club, the Friends of the Piovego (1).
In the post-political quagmire of Berlusconismo, he does not doubt what needs to be done: "The state has failed. The intellectuals have given up. Others talk and pass resolutions. I dig." He does this partly because he is fighting a long-running battle with Padua's mayor, Flavio Zanonato, to preserve the city's Venetian walls and bastions (2), mistreated over the years. "Many of Italy's monuments are lost and buried after centuries of neglect. I am digging to uncover them. The law says that I cannot touch or damage a monument. But I'm not touching or damaging anything – I am bringing it to light. It is the citizen's right to see these monuments. Whenever the mayor sends the police to arrest me, I explain this to them."
Despite the threat of arrest, he continues undaunted. He had just dug down and revealed a cannon emplacement at a depth that showed the true footings of the walls. His plan is to restore the river to its rightful place. He is a radical riverist. "We work with method, patience and determination. Viva Lenin!" Digging is his civic and political action. He likes to quote Marx: "The revolution works with method. Well dug, old mole!" When he digs he lays bare the political and social problems of the city. "Then I bring people here to see the problems. I create aggregations of people. And then, through email, I write about what I am doing, I tell the world: 'Here I am. Come and help me dig'" (3).
'Wooden boats are extinct'
In 1088 the citizens of Pisa and Genoa were goaded by frequent pirate raids from North Africa into sailing over to thrash the pirates. They captured treasures, which they loaded onto Arab ships and brought back to Pisa, but the biggest treasures were the Arab sciences and skills used in organised boat building. A Latin inscription in Pisa cathedral says they found a *portum factum mirabiliter* (a port wondrously made) (4). They copied its design in Italy, and the idea reached Venice, which then changed from crafting boats on the sandy

beaches of the lagoon to making them on the world's first nautical assembly line, in the new-built Arsenale, of which Venetians are justly proud.

Elsewhere, down a long, thin alley behind Venice's beautiful Teatro Italia (long since closed because of budget cuts), I visited a *squero* (boat-builder's yard). The wooden wicket gate displayed the yard's name: Arzanà or arsenal (5). The Pisans brought the word over from North Africa (it's from the Arabic *dar sina'*, a place of manufacture). It is now a boating association run by local people – "true Venetians", as they call themselves. It is a treasure house of bits and pieces salvaged from old craft or donated by local boat-owners: oars, rudders, sails, ropes, lanterns, decorative ironwork and the distinctive wooden oarpost known as the *forcola*: a museum of chandlery.

I suggested to the association's coordinator, Germano Da Preda, that boats and water are the last refuge of civility in our postmodern times. He replied: "The boats are extinct... The waters are very agitated... And civilisation is dead and gone." For the sad fate of Venice, that is as good a place as any to begin. Why this "extinction" of boats? The association had built up a collection of 22 small wooden boats that once worked the waterways of Venice. They collected and stored them nearby.

One day in 2009, the city council evicted the boats and ferried them across the lagoon to the Lido. There they have been left in a field without cover to rot. By the laws of entropy, cost and cultural degradation, wooden boats are being replaced by fibreglass speedboats and oversized outboard motors, in line with the dominant aesthetic of big, fast and oil-fuelled.

A motorboat laden with beer crates came down the narrow channel. Its wake set the Arzanà's two moored boats chafing against each other. My host explained how the constant wave motion from motorboat wakes – *moto ondoso* – is eating away the foundations of the city. The waters are agitated literally as well as metaphorically. Venice is built on sand: when that washes away, things collapse.

And then there is this sense that civilisation is dead. Da Preda's colleague, Marina Bassotto, said the Arzanà was important because it was a means to a minimum of decency in a degraded polity. She has a strong sense of her own powerlessness as a private citizen. She chose her words carefully: "In Italy, we are living a sad period of degradation and desolation." There is blatant corruption on every hand and at every level. It blocks every attempt at social action, and the situation is made worse by all-pervading cynicism and bureaucracy. Cultural associations such as Arzanà are starved of funds and live hand-to-mouth. But by making their gondola collection the focal point of a patient daily work of civic action, education projects in the local schools, publicity and historical research, the association's private citizens come to feel that they can make a difference towards stopping the rot and creating a better future.

Whose Venice?

The right has dreams of taking Venice's city council. Venice has been leftwing for years, because of the industrial working class at Porto Marghera; but industry is now disappearing and society is changing. Property speculators see big killings ahead. There is talk of building a subway to link Venice to the mainland, to the Lido, to the airport. Already half the houses in Venice are empty, owned by foreigners and absentee landlords. True Venetians hate the Disneyfication of their city – the kitsch of the carnival that has now become a commodified mass spectacle, the endless tourists. There is talk of constructing a London Eye-type ferris wheel to dwarf the surroundings. Venetians such as Germano and Marina almost despair of regaining their city.

This year though, somebody had a wonderful idea. The word went round the gondolier associations. At the Arzanà, people brought wine and food. Late at night they boarded their gondolas and departed for the Rialto bridge. As the great bell of San Marco struck midnight to signal the end of carnival, the lights along the Grand Canal were turned off. Motorised boats were banned.

Venetians set off in a procession of small wooden boats and gondolas, under oars and in silence, lit only by thousands of candles. A *vogata in silenzio* (silent procession of boats) went from the Rialto bridge to San Marco. This was their way of taking back their human environment. Turn out the lights, take back the quiet, take back the dark. Turn up the collar of your coat against the bitter north wind, chilled further by the damp of the canals. For a single moment in the whole year, these Venetians felt they could call the city their own.

http://mondediplo.com/2011/04/16venice

There are now no Middle Eastern certainties
No good choices

The democratic Arab revolts are redrawing political, diplomatic and ideological boundaries in the Middle East. Repression in Libya threatened this dynamic process, and we do not know where the UN-approved actions of western forces in support of the Libyan rebels will lead
by Serge Halimi
Even a broken watch tells the right time twice a day. So a UN Security Council resolution authorising the use of force against Libya is not necessarily wrong just because it was a US, French and UK initiative. Unarmed rebels facing a reign of terror may have to seek the assistance of an international force; preoccupied with their own sufferings, they will not refuse help just because the force may be deaf to appeals from other sufferers (for example, in Palestine). They may even forget that the alliance is better known for repression than aid. But reasons that make sense to Libyan rebels in extreme danger cannot justify yet another western war on Arab land. Intervention by Nato member states is not an acceptable way to topple Muammar Gaddafi. If intervention seems the obvious solution – insofar as we are required to choose between western bombardment and the crushing of the Libyan uprising – that is only because other solutions, such as a joint intervention by UN, Egyptian or pan-Arab forces, have been dismissed.
Going by past record, it is impossible to believe the generous motives for sending in western troops that are currently being claimed. In fact, it is hard to believe that any state anywhere would spend money and deploy forces to achieve democratic goals. And recent history shows that battles fought for those goals may have widely acclaimed initial success, but what comes after is chaotic, more dangerous and less spectacular. The capitals of Somalia, Afghanistan and Iraq fell years ago, yet the fighting goes on inside those countries.
The Libyans would have preferred, like their Tunisian and Egyptian neighbours, to end Gaddafi's despotic rule without outside help. The intervention of external forces places them under an obligation to powers that never had any real interest in Libyan freedom. Gaddafi is primarily to blame for this regional exception. Without 40 years of his violent repressive regime (which shifted from an anti-imperialist dictatorship to a pro-western despotism), without his diatribes against the "agents of al-Qaida" and "rats in the pay of foreign intelligence services", the Libyan people alone would have been able to determine their own destiny.
Security Council Resolution 1973 authorising the bombing of Libya may have prevented the crushing of a revolt with military means too slender to succeed. But it has opened the door to much hypocrisy. Gaddafi's troops were not bombed because he was the most vicious or bloodthirsty dictator, but because he was the weakest, without nuclear weapons or powerful friends to shield him from military reprisals or speak for him at the Security Council. The decision to authorise intervention confirms that international law has no clear principles whose violation is subject to universal sanctions.
Gaddafi's close friends
Diplomatic whitewash is like money laundering: one good action covers decades of wheeling and dealing. So President Nicolas Sarkozy could order air strikes against Gaddafi, his former business partner, whom he received in 2007 although the nature of Gaddafi's regime was evident. (We can count ourselves lucky, though, that Sarkozy didn't offer Gaddafi the "French security forces' expertise" that he extended to Tunisia's now ex-president Zine al-Abidine Ben Ali in January.) And Silvio Berlusconi was a "close friend" of the Libyan Guide, who visited him in Rome 11 times, yet Berlusconi managed reluctantly to join the coalition.
The Arab League, full of old men who dread democracy, welcomed UN action but were horrified when the first US missiles landed. Russia and China could have opposed the Security Council resolution or introduced amendments to define the action and reduce the risk of escalation, saving themselves from having to "regret" the use of force later. The rectitude of the international community is also clear from the text of Resolution 1973, which condemns "arbitrary detentions, enforced disappearances, torture and summary executions" in Libya. Of course, these things don't happen in Guantanamo Bay, Chechnya or China.
No one questions the imperative of protecting civilians. But in armed conflict that means bombing military objectives, including troops, many of them civilian conscripts, mingling with unarmed crowds. Aircraft

patrolling a no-fly zone may be shot down, their pilots captured, and special forces will then be sent in to release them. However much the vocabulary is doctored, there is no euphemism for war.
War is in the hands of those who declare it and conduct operations, not those who believe in short wars with happy endings. It is fine to draw up plans for a conflict without hostility and no collateral damage, but the military forces that execute these plans will follow their own inclinations, use their own methods and have their own agenda. The consequences of Resolution 1973 may include retreating Libyan troops mown down by machine guns, as well as crowds rejoicing in Benghazi.
Progressive opinion on Libya is divided, according to whether it stresses solidarity with an oppressed people or opposition to a western war. Both objectives are legitimate but cannot always be reconciled.
Forced to chose, there is a decision to be made on what an "anti-imperialist" label gained in the international arena authorises by way of daily suffering imposed on people.

Wilful silence

Many leftwing governments in Latin America, notably Venezuela, Cuba, Nicaragua and Bolivia have maintained a dignified silence about Gaddafi's repressive measures, which seems all the more bizarre since his opposition to the West is pure facade. He claims to be the victim of a "colonialist plot", after having assured the old colonial powers: "We are all embroiled in the fight against terrorism. Our security services cooperate. We have helped you a lot these past few years" (1).
Like Hugo Chávez, Daniel Ortega and Fidel Castro, Gaddafi claims the attack on him is "all about oil", although Libyan oil is already controlled by the US, UK and Italian companies Occidental Petroleum, BP and ENI (see *The subtleties of Libyan crude*). Just a few weeks ago, the International Monetary Fund had welcomed Libya's "strong macroeconomic performance and the progress on enhancing the role of the private sector" (2). Gaddafi's friend Ben Ali was paid a similar compliment in November 2008 by IMF director general Dominique Strauss-Kahn – who had just returned from Tripoli (3).
Anthony Giddens, theoretician of the Blairite 'Third Way', also seems to have overlooked Gaddafi's old revolutionary, anti-imperialist veneer, carefully restored in Caracas and Havana, when he observed in 2007 that the "ideal future for Libya in two or three decades' time would be a Norway of North Africa: prosperous, egalitarian and forward-looking" (4). Gaddafi has duped many impressive people. He may not be quite as mad as we thought.
There are many reasons why leftwing Latin American governments misjudged Gaddafi. They hoped he was the enemy of their enemy, the US, though that was no reason to believe he was a friend. They didn't know much about North Africa – Chávez phoned Gaddafi to find out what was happening in Tunisia – so they were against what Castro called "the colossal campaign of lies unleashed by the mass media".
The events revived irrelevant personal memories, hence Chávez's comment on Libya: "I don't know why, but the things that have happened and are happening there remind me of Hugo Chávez on 11 April" (11 April 2002, when the Chávez government in Venezuela was almost overturned in a coup with strong media support).

Revolutionary veneer

There were other reasons for the failure to understand events in Libya: decades of US military intervention and domination in Latin America, Libya helping Venezuela to gain a foothold in Africa, Latin American states' role in Opec and the South America-Africa Summits, and Venezuela's diplomatic moves to strengthen South-South relations.
Chávez also assumed that close relations between states meant close relations between heads of state: "King Fahd of Saudi Arabia was a friend of mine, King Abdullah is a friend … The emir of Qatar is a friend, and the president of Syria, he came here too. And Bouteflika" (5). When Gaddafi ("my old friend") and his regime turned repressive, the friendship proved a handicap. Chávez missed the chance to present the Arab uprisings as younger siblings of the leftwing movements in Latin America he knew so well.
It is in the diplomatic arena that one sees most clearly the dire results, in all countries, when power is held by a single individual, and orders are issued without parliamentary control or democratic deliberation. And when, as in the Security Council, diplomats proudly declare war in the name of democracy, the contrast is particularly glaring.
Gaddafi first claimed to espouse the cause of opposing the West and to be defending natural resources; then he played his final card – religion. He explained on 20 March: "The great Christian powers have launched a new crusade against the Muslim people, and the people of Libya first. The aim is to wipe Islam off the map."

Just a fortnight before, he had compared his repressive measures to an action in which 1,400 Palestinians had been killed: “The Israelis had to use tanks to deal with the extremists in Gaza, and we are in the same position … Detachments of the Libyan army had to be deployed against small pockets of al-Qaida” (6). This was unlikely to increase his popularity in the Arab world.

But it has one virtue at least. It makes evident the damaging political effects of language that reflects in reverse the neoconservative talk of crusades and empires. The Arab uprisings with their secular and religious support, and opposition, may end the rhetoric that claims to be anti-imperialist when it is merely anti-West. There may be no more talk in which hatred of “the West” conflates all that is worst (gunboat diplomacy, contempt for the “natives”, wars of religion) and all that is best (from the age of enlightenment to social security) without distinction.

Orientalism in reverse

Not long after the 1979 Iran revolution, the radical Syrian thinker, Sadiq Jalal al-Azm defined, and criticised, an “Orientalism in reverse” that eschewed secular nationalism and communist revolution, and wanted a return to religious authenticity as a weapon against the West.

The principal tenets of this “culturalist” concept, as summarised and refuted by Gilbert Achcar, were that “the degree of emancipation of the Orient should not and cannot be measured by western standards and values, such as democracy, secularism and women’s liberation; that the Islamic Orient cannot be grasped with the epistemological tools of western social sciences and that no analogy with western phenomena is relevant; that the key motional factor in Islamic history, the primary factor setting Muslim masses in motion, is cultural, ie religious, taking precedence over the economic and social/class factors that condition western political dynamics; that the only path of Muslim lands toward their renaissance is through Islam; and that the movements that raise the banner of the ‘return to Islam’ are not reactionary or regressive movements as they are perceived through western lenses, but indeed progressive movements prompted by western cultural domination” (7).

This fundamentalist political vision has not completely disappeared, but the shock waves from Tunisia suggest that its relevance is widely questioned in Arab states where people no longer want to be “with the West, or against it” (8), and where they may be equally critical of a state that is pro-US (Egypt) or against it (Syria). Far from fearing that civil liberties, free speech, democratic policies, trade unions and women’s rights are “western” priorities masquerading as universal liberation, people in Arab states are adopting them as a sign that they reject authoritarianism, social injustice and police states run by old men who treat their people like children. This great drive, reminiscent of other revolutionary movements, these unaccustomed social and democratic victories, this burst of energy all come when “the West” seems divided between fear and apathy, with a necrotic political system, running on automatic toward the same outcomes and on behalf of the same interests, regardless of which coalition is in power.

There is no guarantee that the courage and energy of the Arab people will continue to win easy victories. But they open unknown possibilities. In Article 20 of UN Resolution 1973, the Security Council “affirms its determination to ensure that [Libyan] assets frozen pursuant to [an earlier resolution] shall, at a later stage, as soon as possible be made available to and for the benefit of the people of the Libyan Arab Jamahiriya.” So assets can be frozen and returned to the people. This lesson will certainly be remembered, that the state can serve the people. In the past few months, the Arab world has reminded us of another universal truth: the people can shape the state.

http://mondediplo.com/2011/04/01libyawar#nb1

Well, duh, docs. Even art is fuelled by competitiveness
RUSSELL SMITH

From Thursday's Globe and Mail

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From the Well Duh Science News department – the forefront of obvious science – we learn that scientists have proved that Facebook makes teens depressed. Years of study by the American Academy of Pediatrics have provided evidence that seeing lots of pictures of parties she wasn't invited to can make an adolescent jealous. I wonder how many years we will have to wait for the study that says forget about teens, Facebook makes most adults crazy, in fact it turns them into teens. (The data for that study would be difficult to amass, as it would involve access to all the couples' private e-mails that say something like "Do you really need to be public friends with that girl you dated four years ago?")
We are all also waiting for the American Academy of Pediatrics report on the cumulative effects on young society of watching three or four years worth of "haul" videos, the self-filmed discussion of recently purchased clothes by teenage girls, or their male equivalent, the "unboxing" video, in which an anonymous pair of hands lovingly unwraps a plastic box with something electronic inside it, or, worst of all, "bedroom-tour" videos – those insanely long and fanatically minute detailings, usually by the same teenage girls who are popular "haulers," of every item and surface in an upper-middle-class princess bedroom. Any future study on the effects on girls sharing rooms in public housing of hours and hours of peeking into affluent houses will be predictably depressing. We will easily be able to conclude that teenage envy is the monstrous id unbottled and inflamed by cheap video cameras.
Of course we have already read about the 2010 York University study that analyzed the personalities of 50 students and found that the higher their level of narcissism ("pervasive pattern of grandiosity, need for admiration and an exaggerated sense of self-importance") and the lower their self-esteem, the more time they were likely to spend on Facebook. No prizes will be given to those who were not surprised by this landmark of psychological research.
It should be about as surprising as the 2010 Yale University study that found that a common anesthetic called ketamine was an antidepressant "wonder drug" that could make sad patients feel better within hours. Sounding as much as he possibly could like a satiric Onion article, lead researcher Ronald Duman wrote in the journal Science that most anti-depressants take weeks to take effect but ketamine, astoundingly, works within hours to take away bad feelings. He told news agencies, with childlike wonder, "It's like a magic drug."

No kidding, say a generation of brain-addled ravers who have been calling this particular antidepressant "Special K" for 20 years. I look forward to Professor Duman's next discoveries from the cutting edge of neuropharmacology, drugs called cocaine and ecstasy, which may have similarly rejuvenating powers on the psyche. (In the most hilariously Onion-like turn of their study, the researchers stress that the ketamine must be administered under medical supervision, as it may induce, well, short-term psychotic symptoms. Docs, you could have just Googled "K-hole" and saved yourselves a bunch of lab time.)
I think researchers should spend more time on the effects of more middle-aged narcotics too, such as glossy home-decor magazines. We have no reason to feel superior to materialist teenagers on YouTube: Home-decor mags and shows are the bedroom tours of the university-educated, drugs at once escapist and anxiety-inducing, saturating the reader with money-sucking, marriage-destroying fantasies.
I myself like watching amateur video reviews of new DJ equipment, and even watched one quite detailed one about how a specially designed carrying case opens and closes (so cool I bought one), so must do my best to tone down my condescension. Even our most creative artistic drives are tangled up in the darkest competitiveness, and by our insatiable, starving egos. Even a yearning for the most beautiful architecture can be said to be materialist.
Here's an idea for a scientific study: Let's take the psychic measurements of people who are surrounded by the better-looking in a nightclub, and see if they get anxious, competitive or depressed. Or people who have to go to work with others who make a lot more money than they do. Science may definitively show us that spending time with people is bad for us. And that we should do mind-altering drugs instead.

http://www.theglobeandmail.com/news/arts/russell-smith/well-duh-docs-even-art-is-fuelled-by-competitiveness/article1963556/?utm_medium=feed&utm_source=feedburner&utm_campaign=Feed%3A+TheGlobeAndMail-Entertainment+%28The+Globe+and+Mail+-+Arts+News%29

Dream doctor

From a new memoir, a theory about what happens when we're asleep

By Lisa Birk April 3, 2011

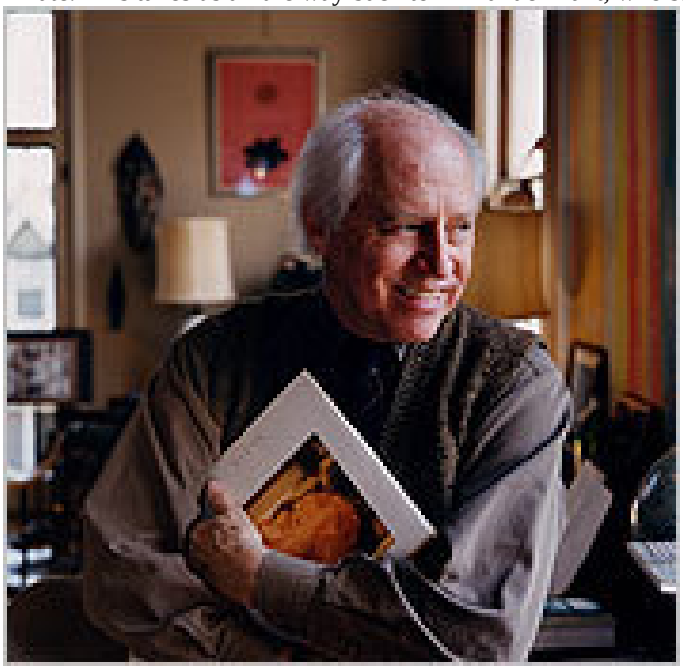
The Harvard psychiatrist J. Allan Hobson was a myth-buster from an early age. At age 4, he personally determined that Santa couldn't fit down his neighbor's chimney; at 8, he dispelled the local superstition that headless snakes don't die until sundown by marching into the woods, finding some snakes, and chopping off their heads.

He built his professional reputation on busting another myth, a big one: Sigmund Freud's theory of dreams. This was the influential idea that dreams are coded messages from our deeper unconscious selves. Aiming squarely at Freud, Hobson and a succession of collaborators documented people's sleep cycles, monitored their brain waves, and tracked chemical changes in the brain. In a series of books driven by five decades of research, Hobson argued that what's really happening when we dream is that our forebrains — the center of thinking and memory — are offline, while our visual, auditory, and emotional centers are not only online, but lit up. Bizarre and powerful dreams aren't caused by repressed desire, he argued, but by biology. Dreams may be fun to think about, but they're really just a side effect of sleep.

Now Hobson, an emeritus professor who lives in Sicily, has written a memoir that moves toward a new theory of dreams. Our dreams do have meaning, he now suggests: It's just not the meaning Freud had in mind.

"Dream Life: An Experimental Memoir" begins — perhaps strangely, for such a committed rationalist — with an imagined scene, the story of his own conception. It tracks his fetal and infant brain development, and then recounts highlights from his work, his family, even his affairs. He uses this data, personal and scientific, to support his new theory, the "protoconscious," activated when we dream. This dreaming self isn't just responding to life (as Freudians would have it), but *rehearsing* for life. And dreams' emotional content can be a window into our own makeup. On average, 30 percent of our dreams are anxious. To Hobson this isn't a problem to be fixed, but information: Perhaps we're biologically programmed to be anxious one-third of the time. As for what we're anxious about — well, that's personal.

This transcript was edited from interviews conducted by phone and via e-mail.
IDEAS: What did Freud get wrong about dreams?
HOBSON: [Sleep researcher] Bob Stickgold says that Freud got it about 100 percent wrong and 50 percent right. What he was right about is that dreaming is important. And that it was very scientifically informative.
IDEAS: In the ’50s when you studied psychiatry at Harvard, Freudianism still reigned?
HOBSON: You know what they were teaching us was wrong. People don’t get schizophrenia because their mothers are sending them double messages. That’s silly. They don’t get schizophrenia because they have the Oedipus complex — *if* they have the Oedipus complex. This is what we were taught!
IDEAS: You built your reputation on studying the mechanics of dreaming, the neurophysiology. Around 2000 something changed, and you began to look at the actual content of dreams.
HOBSON: I had NIMH [National Institute of Mental Health] support for 35 years. They always said, “Study the brainstem, but don’t study the dreams.” OK? So I had become a secret dream scientist. And I couldn’t tell anybody about it. Then I got a phone call from the MacArthur Foundation. “Don’t call us, we’ll call you. You’re a genius. We’ll give you a lot of money. We want you to study dreams!”
IDEAS: Your new theory — you call it “protoconsciousness” — posits that dream content is a rehearsal for life, not simply a reaction to life. Is there a practical application?
HOBSON: The practical application is that a lot of the things that you assume are learned are probably innate. This takes us all the way back to Immanuel Kant, who said that ideas were innate. He argued with



(Graham Gordon Ramsay) Alan Hobson

people like John Locke [who said] that everything was *tabula rasa*. That people were born a blank slate. This kind of argument has been going on for 200 or 300 years. Now we see in dreaming a strong indication that Kant is probably right. That’s why the thing is so important....Because if you assume that everything is learned, then you’re going to make all sorts of mistakes. You’re going to assume you can teach anybody anything. And it’s clear that you can’t.
IDEAS: You’ve written that dream content is random —
HOBSON: I never said that. I said there is a random aspect to content generation.
IDEAS: So in conscious life, can dreaming be helpful?
HOBSON: What I expect to learn a lot from is dreaming, not the dream....The more common dreams are anxious dreams. What does that mean? It means anxiety is more important to survive. Elation is something you do at a party. You do to attract other people. But you better be sure you’re going to get through the jungle before you have the party. You’ve got to survive in order to be happy. What dreams are telling us, I think, is that this is the nature of the beast. It’s not that anxiety is symptomatic. It is that anxiety *is*.

IDEAS: Your book is not a typical memoir. Is there a value to challenging the status quo?
HOBSON: I'm skeptical about any absolute set of rules, scientific rules, moral rules, behavioral rules. I'm very skeptical that one size fits all. That's one reason why I don't feel bad about taking on Sigmund Freud. I think Sigmund Freud has become politically correct. Psychoanalysis has become the bible, and I think that's crazy.
IDEAS: Even now?
HOBSON: Frankly, I'm just as concerned about the current craze with biology, because I think the drug companies are calling all the shots. I think psychiatry has gone from the frying pan into the fire. And what I want to do is I want to pull it out of there. But good luck!
IDEAS: According to "Dream Life," you spent 10 years reading all of Proust twice! Ten pages a day.
HOBSON: I simply admire his persistent and revealing self-analysis and his description of mental life in and at the edges of sleep. His self-observation is much more careful than that of Freud. I have the same goal in my new book: to tell a compelling story openly and honestly. That includes my own sleep, my own dreams, and my own brain troubles. I think we can all contribute to a more naturalistic portrait of ourselves.
IDEAS: Do you have a favorite dream?
HOBSON: I had one in which I'm running across the Swiss Alps. I'm virtually weightless. I'm almost flying. There's water under my feet and yet I don't get wet. I feel great. I see all the mountains. I see all the water. I see the rocks under my feet. It's psychedelic.
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http://www.boston.com/bostonglobe/ideas/articles/2011/04/03/dream_doctor/?page=full

Our False Beliefs About Language

By GEOFFREY NUNBERG

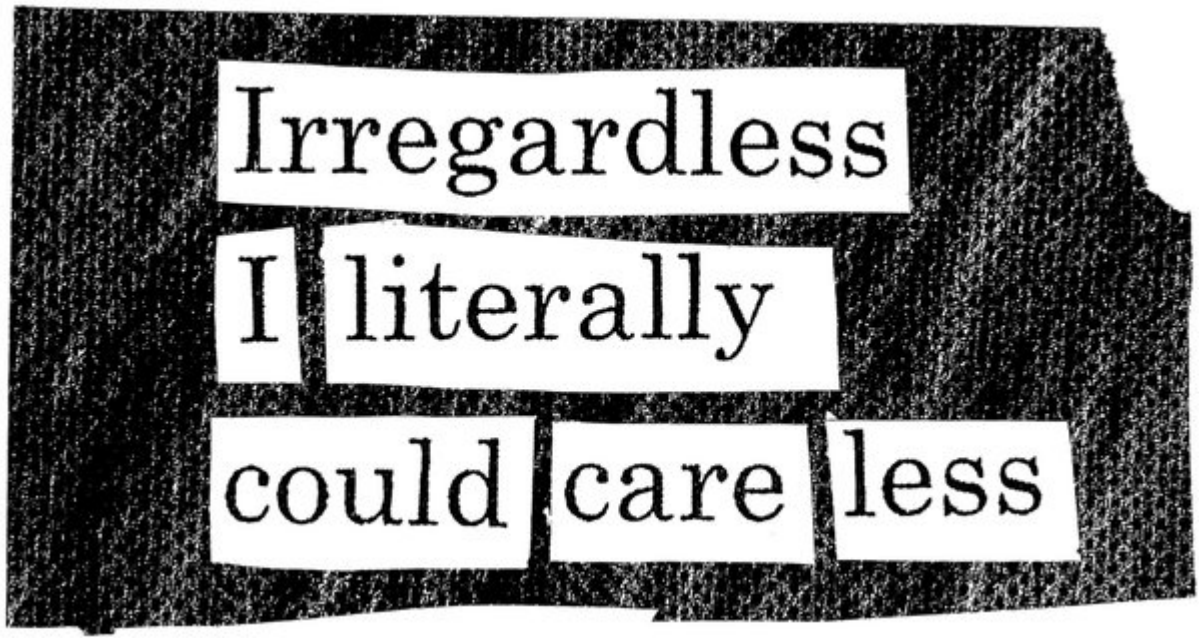


Illustration by Michael Bierut

YOU ARE WHAT YOU SPEAK
Grammar Grouches, Language Laws, and the Politics of Identity
By Robert Lane Greene
312 pp. Delacorte Press. $25.

For nearly a century, linguists have been struggling to unseat the accumulated dogma that "masquerades as common sense," as the American linguist Leonard Bloomfield put it in 1933. That's the challenge that faces every developing science, but linguistics seems to have had a harder time than most. People who readily accept the principles of modern economics, psychology and biology still cling to notions about language that are as antiquated as a belief in physiocracy or leeching.

According to Robert Lane Greene, a correspondent for The Economist, the problem here is a failure to communicate: "Linguists have only themselves to blame for not getting the word out better about what they do." That's not quite fair; the field has been pretty well served by its popularizers, among them scholars like Steven Pinker, John McWhorter and David Crystal. Still, the territory is clearly worth revisiting, and Greene's "You Are What You Speak" is a very readable survey of all the ways our received ideas about language can lead us astray.

Greene makes it his business to dispel popular misconceptions, large and small. (Politicians and pundits, please note: the Chinese word for "crisis" is not composed of the characters for "danger" and "opportunity.") To that end, he visits with the University of Pennsylvania's Mark Liberman, a multifaceted scholar who serves as a one-man truth squad at the Language Log blog, of which he is a co-founder.

In her 2006 book "The Female Brain," for example, Louann Brizendine reported that women average 20,000 words a day against just 7,000 for men. That came as no surprise to many in the media; as one TV reporter put it: "Here's a news flash. Women talk more than men. Duh." But Liberman tracked Brizendine's figures to

an unsourced claim in a self-help book and noted that the empirical research shows both sexes using about the same number of words in a day. Duh! yourself.

And when columnists including George Will and Stanley Fish asserted that President Obama's frequent use of "I" and "me" betrayed his arrogance and self-absorption, Liberman did the counts and showed that Obama actually used those pronouns far less often in speeches and press conferences than did any of his recent predecessors.

"You Are What You Speak" is concerned more with the things people say about language than with the way it works. Readers will gain a deeper understanding of language structure and language change from the books of Pinker and McWhorter. But Greene comes into his own in his knowledgeable discussion of the politics of language in nations from Turkey to Israel to India, and of the folly in trying to regulate language from the top down.

In his view, the efforts of the French to purge their tongue of English words arise in part from a "dented self-image," even though French is hardly a threatened language. And while Americans may bristle at the comparison, he sees the same unwarranted insecurity behind the English-only movement. As Greene notes, English doesn't need protecting; modern immigrants are acquiring the language far more rapidly than immigrants did a century ago and, sadly, are rapidly losing their original languages in the bargain. But that's unlikely to deter the sponsors of English-only measures, which presuppose that recent immigrants have resisted assimilation.

Greene's abhorrence of linguistic meddling extends to the "grouches," "scolds" and "vigilantes" who complain that English is going to hell in a Hupmobile and insist on imposing specious rules and crotchets on a language that is doing quite nicely on its own, thank you. In fact, he argues that the quality of this "declinism" has itself gone downhill over the last century. We've passed from the thoughtful homilies of Fowler to the pithy dictums of Strunk and White to the operatic curmudgeonry of modern sticklers like Lynne Truss, whose gasps of horror at the sight of a misplaced apostrophe are a campy cover for self-congratulation.

There's a lot to this argument. With some notable exceptions, the tone of language commentary has become more shrill even as the "rules" have become ossified and hieratic. Linguists have played a part in that, by reducing these matters to a pseudo-philosophical distinction between "prescriptivism" and "descriptivism" that leaves little place for the fine critical discriminations that make Fowler still so instructive to read. But it doesn't help that these days even the literati have a hazy grasp of grammatical structure. Writers in The New Yorker, The New Republic and National Review often condemn public figures for hiding behind "the passive voice" in sentences like "Acts of terrorism must end" or "That often happens to Israel's critics," which aren't grammatical passives at all.

Greene has some grounds, too, for charging that modern sticklerism is driven by "an aggrieved conservatism, standing against youth, minorities and change." There was clearly a current of displaced racism in reactions to "Ebonics." "Lazy," "slovenly," "ignorant," "gutter" — it was striking how many of the descriptions people applied to black English were the same ones that had been applied to its speakers in the past. And modern jeremiads about the collapse of standards obviously resonate with the rhetoric of the culture wars, at least in the academic theater of operations.

But until 50 years ago, nobody talked about "conservative" and "liberal" positions on usage. And even now, it's not as if liberals care less about usage issues than conservatives do, though they're generally loath to link them to the decline of the West.

Most of the usage questions that engage us daily have nothing to do with politics, race or class, and they almost never figure among the score or so of timeworn bugbears that people report as their pet peeves, like "irregardless," "literally" and "I could care less." (Doesn't anybody know what "pet" means anymore?)

Not long ago I did a double take when I encountered the phrase “refreshingly simplistic” in a music review. When I looked it up on Google, I got hundreds of hits. It seemed to have sprung out of nowhere — these things always do — but it turns out people have been using “simplistic” for at least 40 years to mean something like “plain” or “unadorned.”

Well, language changes, and speakers in a generation or two will probably find my animadversions over “refreshingly simplistic” as tiresome and fusty as I find those by people who still grouse about using “nauseous” to mean sick. (As Greene succinctly puts it, “Yesterday’s abomination is today’s rule.”) Yet the prospect of future acceptance doesn’t allay my feeling that the phrase is a pratfall. It’s as if I’d tried to tell my parents when I was growing up that I shouldn’t have had to wear a jacket to a restaurant, since people a half-century later would be showing up in jeans and flip-flops.

With linguistic opinion so polarized, it’s hard to find fault with a usage without evoking the sticklers and scolds that Greene incisively skewers. But the problem isn’t that we persist in making judgments about language. It’s that we’ve gotten so bad at it.

Geoffrey Nunberg, a linguist, teaches at the School of Information at the University of California, Berkeley.

http://www.nytimes.com/2011/04/03/books/review/book-review-you-are-what-you-speak-by-robert-lane-greene.html?partner=rss&emc=rss

Ballet is dying, warns Sadler's Wells chief

By Rob Sharp, Arts Correspondent
Monday, 4 April 2011

ANNABEL MOELLER
English National Ballet's new version of The Nutcracker

Ballet is in crisis, with fresh talent and ideas struggling to break through and the major companies obsessed with 200-year-old productions at the expense of new work, according to the head of Sadler's Wells, in remarks sure to cause a sharp intake of breath backstage at his more traditional rivals.
Much of the large ballet companies' output lacks variety, according to the Sadler's Wells chief executive Alistair Spalding, who champions new work.
"I'm not saying they don't get broad audiences, but it is often one dimensional," said Mr Spalding.
"There are exceptions but that is essentially the bulk of it, it is 19th century. If there isn't some kind of attention paid to that it is going to end up winding down. It does need new impetus. There is the sense that it does need to be reinvigorated again."
The problem is nothing to do with the recent funding cuts, according to Jennifer Homans, author of Apollo's Angels: A History of Ballet, which prompted international debate last year after she argued that ballet was dying – although the emptying coffers will make things much more difficult.
"Funding is not the problem, it is an artistic problem and money will not solve that," said Ms Homans.
"Alistair is right. We are at a conservative moment in ballet, and dancers need to feel like they are doing new work. Unfortunately, for the most part, the new work is not living up to the old work."
She added: "The crisis in ballet is not a British crisis, it is a general crisis."
Mr Spalding acknowledged that it was difficult for the three biggest ballet companies – the Royal Ballet, English National Ballet and the Birmingham Royal Ballet – to pioneer the unexpected "because new things

are difficult to sell; the audience aren't expecting it". He added: "I think Sadler's Wells has tried to democratise the art form and its success is reflected in the diversity of people that come."
The argument comes days after the big three, and Northern Ballet, were told of a 15 per cent cut in regular Arts Council England (ACE) funding from 2012.
While the Royal Ballet's Alice's Adventures in Wonderland was welcomed by critics earlier this year, it was the company's first all-new, full-length work in 16 years. Over the past year the English National Ballet's The Nutcracker, and Birmingham Royal Ballet's Cinderella, have been well-received, if rare productions of new full-length ballets, but have used existing scores.
Over the next 12 months, the English National Ballet and Birmingham Royal Ballet will each receive £6.4m and £7.6m of ACE funding. The Royal Opera House will receive £26.3m, from which it will fund the Royal Ballet. Mr Spalding also sits on the Arts Council's national council, which oversaw last week's major funding decisions, but refused to discuss individual funding cases.
Ismene Brown, the dance critic, and co-founder of the arts website The Arts Desk, said: "The major ballet companies do not now invest in new work to the degree they should, and the cuts will certainly make that worse."
A spokesman for the English National Ballet insisted that the company has "a very strong output which has already seen the Emerging Dancer Awards take place at the Southbank Centre". A spokesman for the Royal Ballet highlighted the role of its resident choreographer Wayne McGregor in nurturing new choreographers and the company's commitment to putting on new shorter works

http://www.independent.co.uk/arts-entertainment/theatre-dance/news/ballet-is-dying-warns-sadlers-wells-chief-2261417.html

Dirt: The Filthy Reality of Everyday Life, Wellcome Collection, London

Dishing the dirt... or how we learnt to grapple with life's grubby truths
Reviewed by Jenny Gilbert

GETTY IMAGES
A young Venetian woman depicted before and after contracting cholera (1831) Until 31 Aug (020-7611 8545)

Sunday, 3 April 2011
Miasma. Foul air. Stench. These were the words that sent terror into the urban soul of centuries past, when what everyone should have been afraid of was the contents of the jug on their bedroom washstand. But it wasn't until the mid-19th century, after countless thousands of cholera deaths, that the link began to be made between public health and contaminated water.
A "ghost map" of early Victorian Soho drawn up by a London doctor is by no means the most interesting exhibit in the Wellcome Collection's latest exhibition, Dirt: The Filthy Reality of Everyday Life, but it's one of the most significant. Using tiny black blocks, Dr John Snow marked the homes of individual victims of the infection. A dark cluster of marks lining the streets around a particular water pump identified for the first time the devastating link between disease and drinking water polluted with human faeces.
History is rich with progressive victories over dirt, and the exhibition proposes six different places and times to explore changing attitudes, including a Dutch home in 17th-century Delft, a street in early Victorian London and a Glasgow hospital in the 1860s. There are also rooms devoted to Dresden in the early 20th century, present-day Delhi and a future New York landfill site, but somehow this visitor managed to emerge from the show having missed these (perhaps from poor or absent signage – she's at a loss to say how it happened).
One of the smallest exhibits is the world-changing, single-lens microscope designed by Delft scientist Antonie van Leeuwenhoek, through which he discovered microbes, some of them in what he called the "batter" scraped from his teeth. A plasma screen, showing the very varieties of microbe he found in their different

wrigglings and jostlings, makes clear why he termed them animiculae, or "little animals". A magnified dust mite, with its glistening pale-pink carapace and scuttling legs, holds a similar fascination.
It's surely no coincidence that the town of Delft also became famous for its ceramic sanitary wares, and there are exquisite examples displayed of early blue-and-white tiles, and an ingenious chamber pot with a spout. The question of who would have emptied that chamber pot is also addressed, the frontline battle against dirt having always been fought largely by a half-seen underclass of domestics and cleaners. Victorian photography fleshes out the story at this point, documenting the fantastic variety of sanitising tasks undertaken, many of them with a built-in commercial aspect, as in the case of bone grubbers, mudlarks, and the euphemistically named "pure finders" who collected dog faeces for use in tanneries.
The Victorians' ingenious transformation of dust heaps and other debris into housebricks inspires the show's most intriguing contemporary project. The artist Serena Korda invited institutions and members of the public to gather dust from their immediate environment and submit it in a labelled envelope. She then incorporated the material in specially fired terracotta bricks, each imprinted with the donor's initials. The RNIB's brick includes "dog hair from guide dogs", while one that Stephen Geers contributed has "fluff from under my fridge". Less convincing is the "ritualising" of the bricks in a choreographed dance, shown on film. The project culminates in the bricks' burial – dust to dust – completing the circle.
The Wellcome Collection describes itself as "a free destination for the incurably curious". It would take a dullard, indeed, to prefer that this topic be swept under the carpet.

http://www.independent.co.uk/arts-entertainment/art/reviews/dirt-the-filthy-reality-of-everyday-life-wellcome-collection-london-2260487.html

Bob Marley: Rastaman vibration

Thirty years after his death, Bob Marley's legend lives on. But no other artist has matched his enduring influence on music and culture. Why? By Ian Burrell
Wednesday, 6 April 2011

KIM GOTTLIEB-WALKER
'A lyrical message of rare power'; Kim Gottlieb-Walker photographed Bob Marley at his home in Kingston at the height of his career. Thirty years after his death, her images are being shown at a new exhibition in London

Neasden, north London. 1971. The man who would become the first musical superstar to emerge from the developing world is cooped up in a freezing house in one of the capital's greyest and least fashionable suburbs. He has no money, no passport and no work permit. This was Bob Marley at 26, standing on the verge of greatness. His drab, monochrome surroundings belied the fact that he would soon be painting the planet red, gold and green, electrifying audiences on all continents with an original sound that carried a lyrical message of rare power. But less than a decade after Marley left that house in Neasden to make the journey to the Island Records office in Basing Street where he would secure a career-defining deal for the Wailers – the band he formed with childhood friends Bunny Livingston and Peter Tosh – he would be dead.
It is 30 years since we lost Bob Marley. You can't believe it? Just a moment's consideration of music culture now should be enough to tell you how long he has been gone. The flame that, for most of his international audience, began with the albums Catch A Fire and Burnin', shining a new light on injustices and inequalities that had previously been widely ignored, blazed intensely but only briefly. Now it feels like the candle lit in his memory is all but extinguished.
It's not just that the current charts are almost bereft of serious thought or spiritual feeling. Pop music flourished when Marley was alive – when he was in that house in Neasden the British No 1 was "Ernie", a ditty about a milkman by Benny Hill (and still an all-time favourite track of the current Prime Minister). The sad thing is that, in an era when the tourist stalls have replaced the once ubiquitous T-shirts of Bob or John

Lennon with football tops branded with Rooney or Ronaldo, there's almost no one singing about anything of importance. When aspiring artists are encouraged by reality television shows merely to replicate the hits of the past, it's tough being a singer-songwriter, let alone one that wants to change the world.
Marley encouraged musicians to think differently. He was an inspiration to British punk bands in the late 1970s and acknowledged their spirit in his own song "Honkey Reggae Party". His success encouraged the explosion of World Music in the 1980s with South Africa's Lucky Dube and Ivory Coast's Alpha Blondy among the artists who sought to emulate his songs of protest.
His influence extended well beyond the parameters of music. The message in songs such as "Get Up, Stand Up", "So Much Trouble in the World" and "War" would surely resonate with demonstrators in Cairo's Tahrir Square and Libyan rebels in Benghazi. "Bob Marley lives on as an icon – not just in the world of music, but in the social sphere, at the political grassroots, and in the field of human rights," noted the British photographer Dennis Morris, a friend of the musician. Since Morris wrote those words, in 1998, Marley's influence seems to have waned, especially in career-conscious 21st-century Britain.
Even in Jamaica, where Bob led the way in breaking the stigmatisation of Rastafarian culture and making dreadlocks acceptable, there is diminishing evidence of his influence in popular music, with lewd and violent lyrics often holding sway in modern dancehalls. "If Bob Marley was to hear the songs of certain individuals in Jamaica right now he would be horrified," says the reggae DJ David Rodigan.
Perhaps, 30 years after his death, it's a good time to reconsider what Bob Marley left us. His relevance should be particularly strong in Britain, and not just because his father was an English army officer, Captain Norval Marley. He signed that crucial Island Records deal with the label's Anglo-Jamaican founder Chris Blackwell, after coming to Europe with the America singer Johnny Nash and getting stuck in Britain. For a time he lived in London, playing his beloved football with the locals. He made his most famous live recording at the Lyceum Theatre in London in July 1975, filmed the video for "Is This Love" in a north London community centre and helped to inspire the British reggae scene, opening doors for bands such as Steel Pulse and Aswad.
The quality of Marley's work is rooted in the depth of his early life experiences and his long musical education. Separated from his father, he departed the rural parish of St Ann's to live with his mother in the Kingston slums. "After battering around from this dwelling to that one, we finally ended up in a government house in Trench Town," recalled his mother, Cedella Booker, in her biography of her son. He soon began associating with local musicians. "Sometimes Desmond Dekker would come over and the two of them would start jamming together in the bedroom."
In Trench Town he learnt about racial prejudice. "Bob was different from everybody else because he was racially mixed," said Morris in his pictorial biography Bob Marley: A Rebel Life. "He never really saw himself as a black man or a white man: he was Bob Marley. He always said that he had a hard time when he was growing up in Jamaica, coming from a mixed culture. Everybody in Trench Town was very definitely black, so he was an outcast in some ways."
By the time, Bob, Bunny and Peter reached England in 1971, they had been working for eight years. Their earliest recordings for the great Jamaican producer Coxsone Dodd were inspired by the vocal harmonies of American soul groups such as the Impressions and powered by the new rhythms of ska. Songs such as "Simmer Down" and "Jailhouse" reflected the inner city tensions that Marley had experienced and were imbued with the rebel spirit that became his trademark. In 1969, the Wailers joined up with the eccentric Lee Perry, who produced some of the finest compositions of Bob's career, including "Small Axe" and "Duppy Conqueror".
Everyone who met Bob Marley seems to have been touched by his sheer presence, his lion-like visage, majestic air and disarming smile. "He was extremely charismatic and visually, a beautiful man," says Kim Gottlieb-Walker, who photographed Marley at his home in Kingston at the height of his career. She also pictured several of his famously energetic live performances. "He was very dedicated to his music and his message, very serious and conscientious and he demanded the same discipline of his band members. But there was no denying the pure joy and intensity of the performances."
Gottlieb-Walker is exhibiting some of her pictures at a London gallery to mark the 30th anniversary of Bob's death. "He was most comfortable while enjoying the company of friends, family and children, playing football or ping-pong or making music," she says. "At one point I taped some cardboards to the wall of his house at 56 Hope Road in the colours of the Ethiopian flag and asked him to stand in front of them. The first frame was serious and contained...so I stuck my head out from behind the camera and said, 'You know, a lot

of people who see these photos will be people who already love you' and that produced the smiles in the next two frames."

According to the reggae author Lloyd Bradley, writers have always struggled to capture the "essential purity" of Marley, which is more easily defined in photographs than in print. "Bob's face was always as expressive as his words, whether he was laughing, thinking, singing, composing or hopping mad." Women found him irresistible. As well as his three children with wife Rita he had up to eight more with other women, including the former Miss World Cindy Breakspeare. Politicians were also drawn by his aura, in spite of his reluctance to get involved, because of his Rastafarian beliefs. At the One Love Peace Concert in 1978, he brought together the leaders of Jamaica's warring political parties and forced them to join hands during a performance of his party anthem "Jammin'".

Two years later in Harare, at the Zimbabwe Independence Celebrations he performed a set that included the song he had written for that new nation, with its reminder that "Every man got a right to his decide his own destiny" and his advice to Robert Mugabe and colleagues that "Soon we'll find out who is the real revolutionary". Thirty years later, and with the Zimbabwean people suffering under Mugabe's rule, the words are as pertinent as ever.

"The music still resonates today, the people in Libya and Tunisia could be singing the Marley tunes," says Tony Sewell, a former lecturer at Leeds University who is director of Generating Genius, a British and Jamaican charity for boys' education. "You would have to look at the Beatles to see that kind of international currency. It's remarkable that the music has stayed so fresh."

Sewell is another who is depressed by the absence of musicians willing to pick up Marley's baton, particularly in reggae, for which he created a global audience before his death. After an initial explosion of Jamaican talent in the form of singers such as Dennis Brown, Gregory Isaacs, Freddie McGregor and Sugar Minott, the well has dried up. The honey-voiced Garnett Silk was seen as a pretender to the Marley throne (before his death in a gas explosion in 1994), as was Buju Banton, whose 1994 tour accompanying the release of the album 'Til Shiloh drew comparisons with Marley. But Banton's appeal was tainted by accusations of homophobia and his recent conviction for firearm and drugs offences leaves him facing up to 20 years in jail. A huge vacuum remains.

In Sewell's view, Marley's contribution was so vast that it intimidates those who have followed in his wake. "I detect that Jamaica needs to get over Bob Marley in some ways and move on," he says. "I'm wondering if his legacy has left a lot of younger Jamaicans, particularly the artists, feeling, 'Where do we take it to the next stage'. What was refreshing about [the Jamaican Olympic athlete] Usain Bolt coming along was at last we had somebody new."

Jason Hall, deputy director of tourism at the Jamaica Tourist Board, which has used Marley's "One Love" to draw visitors to the island for the past 20 years, says that whenever he travelled as a child he was afforded a special status because of the kudos that Bob's music brought to Jamaicans. "There simply hasn't been any musician like that before or since on a global scale," he says. "Nobody else speaks to freedom, positivity, upliftment and of course love."

In Australia, aboriginal people keep a memorial flame for Marley in Sydney. Among the Hopi tribe of Native Americans he is revered as the fulfilment of an ancient prophecy. But Marley's importance is perhaps felt most keenly of all in Africa. In 2005 I travelled to Ethiopia, the spiritual home of Rastafarianism, when 200,000 people thronged Meskel Square for the Africa Unite concert at which Rita Marley and several of Bob's children, including Damian, Ziggy and Julian, performed to celebrate what would have been his 60th birthday. "Bob Marley for me was a teacher, an academic," a member of the vast crowd, Abel Demsew, an 18-year-old student, told me. "He changed the world smoothly and attractively."

That resonates with Jeff Walker, Gottlieb-Walker's husband and a press officer for Island when Marley made the albums Natty Dread, Rastaman Vibration and Exodus (named by Time magazine as the greatest album of the 20th century). "Bob's primary message was peace and love," he says. "Even in the angrier songs they were talking about situations which would really be best addressed by actions of love as opposed to violence."

It's not that we have forgotten the words to those songs. Those who have grown up with iPods probably have a deeper knowledge of the history of popular music than their parents or grandparents. And Bob Marley's work, particularly his greatest hits album Legend, is on a lot of iPods. When Rodigan recently performed for a student audience in Manchester, the crowd sang along to "Is This Love". "Everyone in that house– average

age 23, tops – knew every single world of that song and that speaks volumes, does it not, for the power of this man's music," he says.
"He has left such a phenomenal legacy, such an imprint upon our conscience."
A similar enthusiasm is engendered by the militant "Buffalo Soldier" and its battle-cry "Woy-oy-oy-oy", by "Sun Is Shining" the Perry-produced classic that has been remixed as a modern dance record, and the stirring "Iron Lion Zion", a track that was discovered only after Marley's death.
On one occasion at Island Records, Bob played Rodigan a recording of "Could You Be Loved" before its release, anxious to know whether it would have a wide appeal. Obviously, he need not have worried. "Bob's music is universal," says the DJ. "You can cue up and play almost any of his records and you are going to have the audience singing along, clapping hands and smiles beaming back up at you."
It might be that no one will ever again scale the musical heights reached by Bob Marley, with his influence not just on the charts but on politics, international relations and human rights. But it would be nice if more modern artists felt inspired enough to at least give it a try.
Bob Marley & The Golden Age of Reggae is on at Proud Camden and runs from 7 April until 15 May. For moreinformation go to www.proud.co.uk

http://www.independent.co.uk/arts-entertainment/music/features/bob-marley-rastaman-vibration-2263426.html

Great Works: The Death of Marat, 1907 (150x200cm) Edvard Munch

Munch Museet, Oslo
By Michael Glover
Friday, 1 April 2011

The paintings of Edvard Munch often confine the onlooker within an unnervingly straitened psychological space. You are present, watching, but it also feels a little like eavesdropping – and a little like entrapment, too. This is especially so of Munch's self-portraits. Munch, like Rembrandt, was an obsessive, life-long self-portraitist, but the way in which these two artists approached the task could not have been more different. The essence of Rembrandt does not change from portrait to portrait – his sense of self was relatively stable. What changes is the costuming. Rembrandt is consistently faithful to the abundant world, which exists outside him with all its gorgeous, fleshy tactility.

With Munch, there is a terrible blurring, if not a smearing, between inner and outer worlds. He is forever taking his own temperature. In a relatively early one, the Self-Portrait with a Burning Cigarette of 1895, he shows himself, though eerily lit, to be a debonair, raffish smoker, almost clubbable. Never again. Generally speaking, when Munch paints himself, he does so in order to prove that he exists, that he is still fully embodied. His portraits are nervy, febrile, tense in the extreme. He changes, and changes again. He seems to be present at a haunting – but the person doing the haunting, and the person who is being haunted, happen to be the very same man whose face he confronts in the mirror every wretched, workaday morning. His colours are often feverishly wild and unpredictable. They are faithful to nothing but the vision of Edvard Munch. The more intense the reds, the purples, the yellows, the worse things are going.

So what exactly is being enacted in this strange work? It shares its title with a celebrated painting of 1793 by the memorialist of the French Revolution, Jacques-Louis David, which showed the revolutionary leader, Jean-

Paul Marat, dying in his bath. When David paints Marat dying, there is no sign of the murderess, Charlotte Corday.

In Munch's version, the malignant woman dominates the proceedings. What a wild state of affairs is conjured here! Look how it is painted, all this ferocious whirlpooling of brush strokes. The entire painting is like a kind of emotional maelstrom. Everything comes at us all at once, tipping and lurching, with great vividness and violence. The use of colour is almost anti-irrational – as if Munch is cocking a snook at the power of human reason to make sense of our terrible, howling complexities. The marks of the brush – horizontal, vertical and many points in between – are ferociously apparent across the painted surface, like some brutal ritual of scarification.

And yet throughout this wild evocation, the murderess seems to float towards us, almost ghost-like in her thin, pallid, unnerving, hour-glass-like beauty of sorts. She seems so strangely settled in her otherworldly indifference to her own crime. A huge, ominous shadow – of what? – hulks at her back, as if to suggest that much is not what it seems. The murdered man himself is like so much detritus – crude, puppet-like, and unlovingly flung to one side like a bloody, discarded mannequin.

Although Munch is pretending to distance the work from his autobiography by associating it with a key moment in the French Revolution, this is in fact a feint. He is referring to events in his own troubled life. The ghostly Charlotte resembles his sometime lover, Tulla Larsen. The blood that is smeared across the bed on which the murdered man lies is also rooted in the particular. Munch had shot himself in the finger after a row with Tulla in 1902. A certain amount of blood had flowed. His feverish imagination would never let him forget that act. Now we see it again, fully transfigured, and even sensationalised. As in so many paintings by Munch, he is also addressing the nature of the war between the sexes, the terrible, vampiric unpredictability of the feminine, so seductive, and yet so fear-inducing.

ABOUT THE ARTIST

The Norwegian painter Edvard Munch (1863-1944) is a conjuror of disturbing psychological states. He painted his famous work, 'The Scream' (1893), over and over again. He was not so much interested in painting reality, as in trying to discover the heightened visual equivalent of intense human feeling.

http://www.independent.co.uk/arts-entertainment/art/great-works/great-works-the-death-of-marat-1907-150x200cm-edvard-munch-2258467.html

The death of architecture

Unless you're a 'starchitect', chances are you'll end up creating mediocre glass-clad hangars, says Jay Merrick. Does the problem lie with the profession, or the politicians in charge of our towns and cities?

ALAMY
Sainbury's in Plymouth
Monday, 4 April 2011
British architects have become political and cultural punch-bags, and the Budget's "radically relaxed" planning rules in Enterprise Zones will batter them even more. Ruth Reed, president of the Royal Institute of British Architects (Riba), welcomes the Chancellor's proposal with a pathos-laden hope that the new rules will "protect the essential requirements of sustainability and good design".
George Osborne's "gift" to enterprise, and Ms Reed's painfully dutiful response to it, highlights the fact that the architectural profession is riven by confusion. Are architects cultured designers or glorified triage surgeons working in towns and cities lacerated by architectural collateral damage caused by political and commercial expediency, rubber-stamped by planners?
Michael Gove, the Education Secretary, thinks architects are conniving bread-heads. Sir David Chipperfield, one of Britain's most culturally thoughtful architects, says the profession's rising generation of new talent has been blocked from competing for major projects. Our Government has no rigorous interest in architectural standards. And now, even the Riba is daring to suggest that the current version of homo architectus could die out by 2025.
The modern architectural quality of our towns and cities has been under mounting pressure since Margaret Thatcher stripped away in-house architectural and urban planning expertise from most local authorities. Thirty years on, the way buildings and places are conceived and designed seems to be collapsing into world-class mediocrity at precisely the time the Government pursues soundbite initiatives such as the World Class Places scheme, which will allegedly make our communities "high quality, safe and more sustainable places to live in".

The very word "architect", says the Riba's Building Futures think-tank report, "is perceived to hold practices back in terms of the type of work they are able to do. Some practices have already created offshoot companies with a separate identity and different branding to their main practice, avoiding use of the title 'architect' in order to reach more diverse markets and branch into areas such as lighting design, product design, industrial design, interior design, installation design, branding and community consultation".

And we might be tempted to think: so what? As the designer William Morris said in 1889, the only historical constant is perpetual change. Stuff happens; people and places evolve; architects invariably adapt to any situation, or client.

But are clients and planners always serving places and cultures in the fullest way possible? And if they're not, architects are complicit in creating buildings and places that may have little or no formal contextual or cultural value.

Architects serve commercial forces that are generally uninterested in the complex cultural qualities of place, aesthetics and history – and our planning system struggles to cope with the tensions, and the bad architecture, generated by this situation. From design to delivery, architecture is being corporatised and re-calibrated as part of sophisticated management systems. Architects are increasingly seen as service-industry operatives and it cannot be long before student architects' reading lists include tomes on the management and production structures of exemplars of global corporate efficiency such as Toyota, Walmart and Tesco.

Most architects spend about 5 per cent of their time actually designing, partly because they're up to their necks in gruelling, and often turgidly repetitive, consultations and client meetings. Their early designs are fed through clients' value-engineering software, and if the projected commercial outcomes don't match client expectations, the idea is shredded. This is not necessarily a bad thing, but it encourages passively compromised design and, ultimately, architecturally dumbed-down places.

This situation is exacerbated by deep uncertainties about the way architects are trained. Consider two successive recent editorials in Building Design magazine. The first, by its editor-in-chief, Amanda Baillieu, argued that architects' education must change because they are "not equipped to do anything other than design buildings". The second, by its editor, Ellis Woodman, concluded with the words: "The crisis in architectural education is not that schools are failing to deliver an education in business, but that too many of them are failing to deliver an education in architecture."

These views should not be seen as crudely contradictory: they are the yin and yang of a vital debate at a time when more architectural practices are fragmenting in search of work – a trend that may further separate individual architects from the need to understand, and care about, the relationship between their work and its effect on the quality of places and lives.

No wonder architects, en masse, already suggest clones of Slartibartfast in The Hitchhiker's Guide To The Galaxy, whose only nerdy skill was designing fjords. By 2025, an even more tragicomic remark from Douglas Adams' satire may be more appropriate to legions of marginalised architects: "There's an infinite number of monkeys outside who want to talk to us about this script for Hamlet they've worked out."

How has this come about? The Government and the architectural profession have been dominated by powerful inertia. Local authorities, desperate to regenerate chunks of their towns and cities, squeeze politically useful bolt-ons out of developers – implants of housing, car parks, link-roads and public spaces that councils can't afford to build. But architectural quality isn't ring-fenced and most councils can't risk spending six-figure sums to contest second-rate developers' appeals on projects that belong only on Crap Town postcards. The Government seems satisfied with this sado-masochistic, quick-fix approach to regeneration, which was cemented into place after the economic crash in 2008.

Since then, there has been a 40 per cent slump in demand for architects' services. Many practices have not only dropped their fees, but are doing design-preparation work for nothing. If architectural quality continues to be degraded, it won't be a subject for meaningful discussion at any level. And it won't be fought for in the places where it matters most – I don't mean in the prime locations where blingkrieg architecture will always prevail, but in the ordinary, relatively unremarkable parts of our towns and cities.

The promoters of Big Society – and New Labour before them – have demonstrated no rigorous interest in promoting meaningful architectural standards. New Labour, for example, presided over the absurdly constipated idea that individual, commercially led consortia had to waste at least £3m just to compete for a single project in the now ditched £55bn Building Schools for the Future programme. If a consortium won, say, one in four school projects, then several compensatory millions had to be slashed from the cost of the

schools they did build. As a result – and there are admirable exceptions – many of these schools have a deadly, stalag-like look to them.
Gove says architects creamed off big profits from these school projects when, quite evidently, most of them were implicitly cost-squeezed from the outset. Speaking at a recent conference on the new free schools programme, he declared: "And we won't be getting Richard Rogers to design your school. We won't be getting any award-winning architects to design it, because no one in this room is here to make architects richer." He made similar remarks, reported in Hansard, last June.
But there is more to the alleged impending death of the architect than Mr Gove despising "rich" architects even as his Government allows banks and their "y'all right there?" staff to provide satirical financial services to Les Misérables, while the City mass-produces new regiments of the super-rich. The profound effects of corporate and Government inertia on the fate of architects and architecture is further tainted by the historical image of architects and the architectural establishment, and by the way our towns and cities are increasingly seen by planners and developers as virtual realms – urban diagrams that can be tidied up and made more profitably controllable.
It is hard for most architects not to harbour the idea that they are faintly God-like: cue image of William Blake's divider-wielding deity in The Ancient of Days. Architects are, after all, the nominal descendants of geniuses such as Alberti, Palladio, Hawksmoor, Lutyens, Le Corbusier and Aalto. And since the beginning of the 20th century, their role models have tended to behave with insouciant arrogance.
When one of Frank Lloyd Wright's wealthy clients complained that a leak in the ceiling was dripping water on a valuable table, Wright replied: "Move the table." And when Sir Basil Spence made final checks on the fixtures and fittings of the University of Sussex campus in the 1960s, he suddenly began to smash light fittings with his walking stick. "Not what I specified," he barked. "Replace them!" In the early 1990s, Peter Rees, the City's planning supremo, attempted to check required design changes on One Poultry, whose architect was the famously imposing Sir James Stirling. "I've made the changes," Stirling growled, "and you don't need to see them."
Unless your name is Frank Gehry, Zaha Hadid, Renzo Piano, or Norman Foster, those imperious days have gone – but their aura remains. Yet it is the client, cultured or philistine, who is now king. Very few have the architectural intelligence of, say, Lord Palumbo, who commissioned One Poultry, nor do they often exhibit the architectural and placemaking ambition of the mere handful of developers currently working with master architects such as David Chipperfield and Eric Parry, and with outstanding, highly cultured younger practices.
In Britain, the rise of new architectural talent is not supported strongly enough. Chipperfield complained in The Architects Journal that the Riba's "soft" attitude towards organising design competitions was stultifying: "I think there were five open design competitions in the UK last year. There were 200 in Germany and 1,600 in France. I think that's shocking." His inference is that too many British architectural competitions have produced same-old same-old outcomes. Talented younger architects who are not inclined to fag for the establishment's prefects are at a major disadvantage.
Many younger architects are also profoundly puzzled by what is currently regarded as impressive architecture. Why, indeed, should anybody think architects are making anything other than superficial contributions to our lives and built environment when they encounter tinny, eerily temporary-looking developments – yet more colour-saturated urban stage-sets littering Britain's so-called urban renaissance with cynical gimcrack architecture that might as well have been designed by marketing wonks, or extruded from the pages of JG Ballard's novel, The Atrocity Exhibition: "Desperate for the new, but disappointed with anything but the familiar, we recolonise past and future."
British cities, as Owen Hatherley rightly says in A Guide To The New Ruins of Great Britain, "deserve better than to be reduced to a systematic regeneration formula of 'stunning riverside developments' and post-industrial leisure in the urban core, and outside it a sprawl of distribution sheds, retail parks and reduced versions of the houses of 150 years ago".
Why don't those who are reinventing our built environment demand better, more thoughtful architects, better materials, better urban thinking, better ethics? Because, in many instances, they simply don't need to spend 3 or 4 per cent more of their development budgets on these absolutely crucial things to gain planning permission. The new pathology of socio-urban change spreads across countless petri dishes of redevelopment: tranquilised, CCTV-monitored town and city centre regenerations and blustering Enterprise Zones certainly

create jobs, shopping and housing – but how often do they convey any sense of a vividly engaging plunge into fresh urban, architectural and cultural richness?

It doesn't help that the media often treat architecture as if it were mordant entertainment that has more to do with both the Orwellian and postmodern versions of Big Brother than with any thoughtful discussion of architectural quality. We have become supplicants to the iconic and its Zen of architectural bling. And if architects and architecture are perceived as faintly trivial, why should governments, or the silverbacks roaming our towns and inner cities in search of development parcels, pay more than lip-service to what architects think or say?

Yet it isn't just cardboard cut-out feral developers, abject planners and Government ministers talking puerile nonsense about architecture that threatens to transform most architects into plug-in design drones. Across two decades of helter-skelter socio-economic change, architects have simply failed to get a hugely important message across to the public, to planners and to those in Goveland. It is that architects and architecture of unmistakable quality are absolutely crucial to the future intelligible meaning of our cultural and commercial landscapes.

If Big Brother's clock does strike 13 in 2025 for Britain's 28,000 architects, they will not only find themselves members of the Royal British Institute of British Slartibartfasts – they will form an army of querulous, closely controlled Winston Smiths recomposing our towns and cities, via "radically relaxed" planning rules, into an endlessly craven series of Room 101s extracting maximum profit from maximum architectural defeat.

http://www.independent.co.uk/arts-entertainment/architecture/the-death-of-architecture-2261212.html

The workshop that changed the world

By Jay Merrick, Architecture Correspondent
Wednesday, 23 March 2011

Science Museum, London
Watt's Workshop, 1924
A view by local photographer J Willoughby Harrison just before the workshop was moved in 1924. The tall sculpture copying machines which Watt spent his retirement building dominate the room.

The room measures 6m by 5m, and could almost be a hyper-quaint visualisation from an animatronic version of a Dickens novel starring an orphaned fish with Eddie Murphy's voice. And yet it was in this attic workshop - restored and open to the public from today at London's Science Museum - that James Watt, inventor of the modern steam engine, presided over the industrial revolution.
In his day, Watt was as famous as Shakespeare, and was the first mechanical engineer to be commemorated in Westminster Abbey. When the imperious Prussian architect Karl Friedrich Schinkel visited Manchester in 1825, he was dumfounded by the ruthless efficiency of Manchester's factories. By then, the patented Watt steam engines in them had already proved themselves in Cornish mines, in the industrial hellfire of the foundries of Shropshire and Staffordshire, and in London's breweries.
While the poet and artist William Blake craved a new and romantically historic Jerusalem that would replace these dark satanic mills, Watt remained implacably of the future – not just as the first ultra-rational industrial designer, but the man who invented the idea of flexible factory spaces more than a century before Henry Ford built his factory in Detroit. That concept alone qualifies Watt as the first shock-of-the-new modernist 140 years before the official birth of the movement that gave us sanitation, skyscrapers, super-Jumbos and our permanent oil crisis.
Watt changed the course of history while walking in Glasgow Green park on a Sunday in May, 1764. He'd been trying to repair a Newcomen steam engine and was fretting about its crudely inefficient use of heat and steam. "I had not walked further than the golf house," he recalled later, "when the whole thing was arranged in my mind."

By the time Watt had his steam engine eureka moment, he'd already produced a stream of improvements to musical and scientific instruments, invented the first circular saw blades, and concocted a letter-copying machine which used his own brand of ink.

After moving to Birmingham to work with the equally progressive metal products manufacturer Adam Boulton, the Watt steam engine rapidly gave Britain an industrial lead over Europe and America that it was to hold for the best part of a century. said: "It wasn't just Wellington and Nelson who triumphed over the French," says Science Museum curator Andrew Nahum. "Watt was seminal to the success of our industrial revolution because he wanted to make a profit out of science."

Watt's design solutions did not arise from perfectly ordered surroundings. His workshop is a thoroughly messy overlapping of objects and projects that seems to have been crucial to his famously restless mind. The room is a musty time-capsule of his genius, and has been meticulously recreated in the Science Museum's new gallery. An incurving glass wall allows visitors to stand in the middle of the workshop, surrounded by its contents.

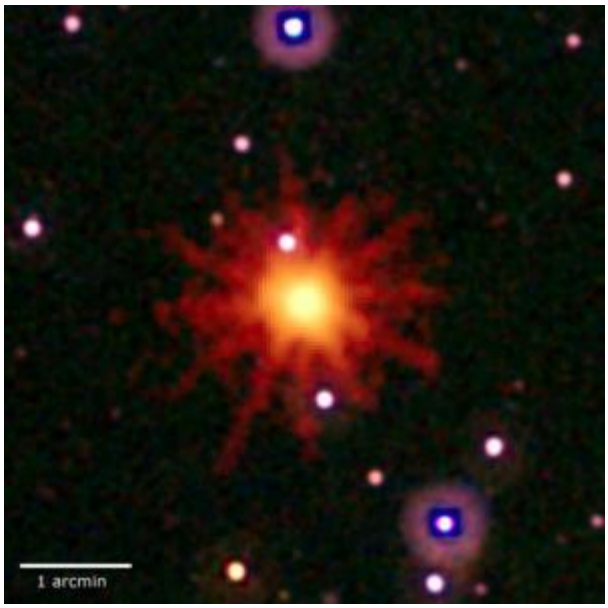
It's extraordinary to think that Watt's seismic influence on the industrial world - and, ultimately, on the way we live in the 21st century - could have come from nothing more than this cramped attic space. The workshop, locked after his death in 1819 and carefully preserved as a shrine, was brought to London in 1924. It contains 8,434 objects, including a stove, frying pan, writing desk, lathe, workbench, flasks, moulds, dozens of dusty packets of chemicals, scores of crammed pigeon-holes, a box full of rock fragments, and chunks of marble for his sculpture-copying machine.

In our age of nerdy specialisms, this small, rather dark room radiates a sombre grandeur. The Science Museum's director, Ian Blatchford, admits that the institution has ignored its vast trove of scientific objects for a decade, in favour of interactive displays. James Watt's strangely compelling workshop proves that the virtual – with or without an Eddie Murphy voiceover – can never be quite as engrossing as the hard evidence of scientific advance.

James Watt and our World, a permanent exhibition at the Science Museum, London, opens today

http://www.independent.co.uk/arts-entertainment/architecture/the-workshop-that-changed-the-world-2250607.html

Black Hole May Have Ripped Star Apart Causing Unprecedented Explosion



Images from Swift's Ultraviolet/Optical (white, purple) and X-ray telescopes (yellow and red) were combined in this view of GRB 110328A. The blast was detected only in X-rays, which were collected over a 3.4-hour period on March 28. (Credit: NASA/Swift/Stefan Immler)

ScienceDaily (Apr. 7, 2011) — NASA's Swift, Hubble Space Telescope and Chandra X-ray Observatory have teamed up to study one of the most puzzling cosmic blasts yet observed. More than a week later, high-energy radiation continues to brighten and fade from its location.

Astronomers say they have never seen anything this bright, long-lasting and variable before. Usually, gamma-ray bursts mark the destruction of a massive star, but flaring emission from these events never lasts more than a few hours.

Although research is ongoing, astronomers say that the unusual blast likely arose when a star wandered too close to its galaxy's central black hole. Intense tidal forces tore the star apart, and the infalling gas continues to stream toward the hole. According to this model, the spinning black hole formed an outflowing jet along its rotational axis. A powerful blast of X- and gamma rays is seen if this jet is pointed in our direction.

On March 28, Swift's Burst Alert Telescope discovered the source in the constellation Draco when it erupted with the first in a series of powerful X-ray blasts. The satellite determined a position for the explosion, now cataloged as gamma-ray burst (GRB) 110328A, and informed astronomers worldwide.

As dozens of telescopes turned to study the spot, astronomers quickly noticed that a small, distant galaxy appeared very near the Swift position. A deep image taken by Hubble on April 4 pinpoints the source of the explosion at the center of this galaxy, which lies 3.8 billion light-years away.

That same day, astronomers used NASA's Chandra X-ray Observatory to make a four-hour-long exposure of the puzzling source. The image, which locates the object 10 times more precisely than Swift can, shows that it lies at the center of the galaxy Hubble imaged.

"We know of objects in our own galaxy that can produce repeated bursts, but they are thousands to millions of times less powerful than the bursts we are seeing now. This is truly extraordinary," said Andrew Fruchter at the Space Telescope Science Institute in Baltimore.

"We have been eagerly awaiting the Hubble observation," said Neil Gehrels, the lead scientist for Swift at NASA's Goddard Space Flight Center in Greenbelt, Md. "The fact that the explosion occurred in the center of a galaxy tells us it is most likely associated with a massive black hole. This solves a key question about the mysterious event."

Most galaxies, including our own, contain central black holes with millions of times the sun's mass; those in the largest galaxies can be a thousand times larger. The disrupted star probably succumbed to a black hole less massive than the Milky Way's, which has a mass four million times that of our sun

Astronomers previously have detected stars disrupted by supermassive black holes, but none have shown the X-ray brightness and variability seen in GRB 110328A. The source has repeatedly flared. Since April 3, for example, it has brightened by more than five times.
Scientists think that the X-rays may be coming from matter moving near the speed of light in a particle jet that forms as the star's gas falls toward the black hole.
"The best explanation at the moment is that we happen to be looking down the barrel of this jet," said Andrew Levan at the University of Warwick in the United Kingdom, who led the Chandra observations. "When we look straight down these jets, a brightness boost lets us view details we might otherwise miss."
This brightness increase, which is called relativistic beaming, occurs when matter moving close to the speed of light is viewed nearly head on.
Astronomers plan additional Hubble observations to see if the galaxy's core changes brightness.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **NASA/Goddard Space Flight Center**.

https://amsprd0102.outlook.com/owa/?wa=wsignin1.0

Political Views Are Reflected in Brain Structure

Individuals who call themselves liberal tend to have larger anterior cingulate cortexes, while those who call themselves conservative have larger amygdalas. Based on what is known about the functions of those two brain regions, the structural differences are consistent with reports showing a greater ability of liberals to cope with conflicting information and a greater ability of conservatives to recognize a threat, the researchers say. (Credit: iStockphoto/Steve Greer)

ScienceDaily (Apr. 7, 2011) — We all know that people at opposite ends of the political spectrum often really can't see eye to eye. Now, a new report published online on April 7th in *Current Biology*, reveals that those differences in political orientation are tied to differences in the very structures of our brains.

Individuals who call themselves liberal tend to have larger anterior cingulate cortexes, while those who call themselves conservative have larger amygdalas. Based on what is known about the functions of those two brain regions, the structural differences are consistent with reports showing a greater ability of liberals to cope with conflicting information and a greater ability of conservatives to recognize a threat, the researchers say.

"Previously, some psychological traits were known to be predictive of an individual's political orientation," said Ryota Kanai of the University College London. "Our study now links such personality traits with specific brain structure."

Kanai said his study was prompted by reports from others showing greater anterior cingulate cortex response to conflicting information among liberals. "That was the first neuroscientific evidence for biological differences between liberals and conservatives," he explained.

There had also been many prior psychological reports showing that conservatives are more sensitive to threat or anxiety in the face of uncertainty, while liberals tend to be more open to new experiences. Kanai's team suspected that such fundamental differences in personality might show up in the brain.

And, indeed, that's exactly what they found. Kanai says they can't yet say for sure which came first. It's possible that brain structure isn't set in early life, but rather can be shaped over time by our experiences. And, of course, some people have been known to change their views over the course of a lifetime.

It's also true that our political persuasions can fall into many more categories than liberal and conservative. "In principle, our research method can be applied to find brain structure differences in political dimensions other than the simplistic left- versus right-wingers," Kanai said. Perhaps differences in the brain explain why some people really have no interest in politics at all or why some people line up for Macs while others stick

with their PCs. All of these tendencies may be related in interesting ways to the peculiarities of our personalities and in turn to the way our brains are put together.
Still, Kanai cautioned against taking the findings too far, citing many uncertainties about how the correlations they see come about.
"It's very unlikely that actual political orientation is directly encoded in these brain regions," he said. "More work is needed to determine how these brain structures mediate the formation of political attitude."

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Cell Press**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Ryota Kanai, Tom Feilden, Colin Firth, Geraint Rees. **Political Orientations Are Correlated with Brain Structure in Young Adults**. *Current Biology*, 07 April 2011 DOI: 10.1016/j.cub.2011.03.017

http://www.sciencedaily.com/releases/2011/04/110407121337.htm

Technique for Letting Brain Talk to Computers Now Tunes in Speech

Scientists at Washington University School of Medicine in St. Louis have adapted brain-computer interfaces like the one shown above to listen to regions of the brain that control speech. (Credit: Eric Leuthardt, MD)

ScienceDaily (Apr. 7, 2011) — The act of mind reading is something usually reserved for science-fiction movies but researchers in America have used a technique, usually associated with identifying epilepsy, for the first time to show that a computer can listen to our thoughts.

In a new study, scientists from Washington University demonstrated that humans can control a cursor on a computer screen using words spoken out loud and in their head, holding huge applications for patients who may have lost their speech through brain injury or disabled patients with limited movement.

By directly connecting the patient's brain to a computer, the researchers showed that the computer could be controlled with up to 90% accuracy even when no prior training was given.

Patients with a temporary surgical implant have used regions of the brain that control speech to "talk" to a computer for the first time, manipulating a cursor on a computer screen simply by saying or thinking of a particular sound.

"There are many directions we could take this, including development of technology to restore communication for patients who have lost speech due to brain injury or damage to their vocal cords or airway," says author Eric C. Leuthardt, MD, of Washington University School of Medicine in St. Louis.

Scientists have typically programmed the temporary implants, known as brain-computer interfaces, to detect activity in the brain's motor networks, which control muscle movements.

"That makes sense when you're trying to use these devices to restore lost mobility -- the user can potentially engage the implant to move a robotic arm through the same brain areas he or she once used to move an arm disabled by injury," says Leuthardt, assistant professor of neurosurgery, of biomedical engineering and of neurobiology, "But that has the potential to be inefficient for restoration of a loss of communication."

Patients might be able to learn to think about moving their arms in a particular way to say hello via a computer speaker, Leuthardt explains. But it would be much easier if they could say hello by using the same brain areas they once engaged to use their own voices.

The research appears April 7 in *The Journal of Neural Engineering*.

The devices under study are temporarily installed directly on the surface of the brain in epilepsy patients. Surgeons like Leuthardt use them to identify the source of persistent, medication-resistant seizures and map those regions for surgical removal. Researchers hope one day to install the implants permanently to restore capabilities lost to injury and disease.

Leuthardt and his colleagues have recently revealed that the implants can be used to analyze the frequency of brain wave activity, allowing them to make finer distinctions about what the brain is doing. For the new study, Leuthardt and others applied this technique to detect when patients say or think of four sounds:

- oo, as in few
- e, as in see
- a, as in say
- a, as in hat

When scientists identified the brainwave patterns that represented these sounds and programmed the interface to recognize them, patients could quickly learn to control a computer cursor by thinking or saying the appropriate sound.
In the future, interfaces could be tuned to listen to just speech networks or both motor and speech networks, Leuthardt says. As an example, he suggests that it might one day be possible to let a disabled patient both use his or her motor regions to control a cursor on a computer screen and imagine saying "click" when he or she wants to click on the screen.
"We can distinguish both spoken sounds and the patient imagining saying a sound, so that means we are truly starting to read the language of thought," he says. "This is one of the earliest examples, to a very, very small extent, of what is called 'reading minds' -- detecting what people are saying to themselves in their internal dialogue."
"We want to see if we can not just detect when you're saying dog, tree, tool or some other word, but also learn what the pure idea of that looks like in your mind," he says. "It's exciting and a little scary to think of reading minds, but it has incredible potential for people who can't communicate or are suffering from other disabilities."
The next step, which Leuthardt and his colleagues are working on, is to find ways to distinguish what they call "higher levels of conceptual information."
The study identified that speech intentions can be acquired through a site that is less than a centimetre wide which would require only a small insertion into the brain. This would greatly reduce the risk of a surgical procedure.

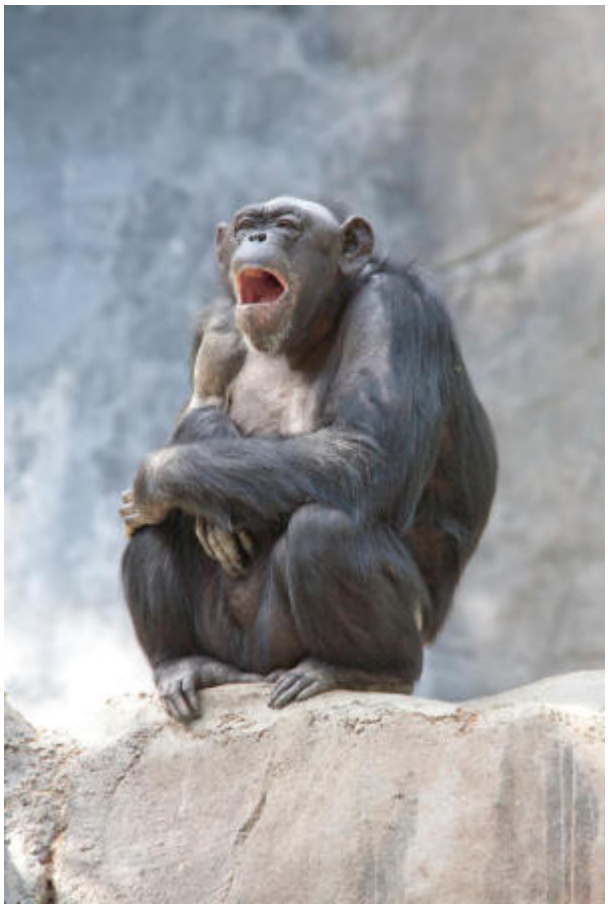
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Washington University School of Medicine**. The original article was written by Michael C. Purdy.

Journal Reference:

1. Eric C. Leuthardt, Charles Gaona, Mohit Sharma, Nicholas Szrama, Jarod Roland, Zac Freudenberg, Jamie Solis, Jonathan Breshears, Gerwin Schalk. **Using the electrocorticographic speech network to control a brain–computer interface in humans**. *Journal of Neural Engineering*, 2011; DOI: 10.1088/1741-2560/8/3/036004

http://www.sciencedaily.com/releases/2011/04/110406192422.htm

Chimpanzees' Contagious Yawning Evidence of Empathy, Not Just Sleepiness, Study Shows



Contagious yawning is not just a marker of sleepiness or boredom. For chimpanzees, it may actually be a sign of a social connection between individuals. (Credit: iStockphoto/Jose Gil)

ScienceDaily (Apr. 7, 2011) — Contagious yawning is not just a marker of sleepiness or boredom. For chimpanzees, it may actually be a sign of a social connection between individuals.

New research at the Yerkes National Primate Research Center, Emory University, may help scientists understand empathy, the mechanism thought to underlie contagious yawning, in both chimpanzees and humans. The research also may help show how social biases strengthen or weaken empathy.

Scientists at Yerkes discovered chimpanzees yawn more after watching familiar chimpanzees yawn than after watching strangers yawn. The *Public Library of Science One* (*PLoS ONE*) is publishing the study online on April 6, 2011.

Yerkes researchers Matthew Campbell, PhD, and Frans de Waal, PhD, propose that when yawning spreads between chimpanzees, it reflects an underlying empathy between them.

"The idea is that yawns are contagious for the same reason that smiles, frowns and other facial expressions are contagious," they write. "Our results support the idea that contagious yawning can be used as a measure of empathy, because the biases we observed were similar to empathy biases previously seen in humans."

Campbell is a FIRST postdoctoral fellow at Yerkes and Emory (Fellowship in Research and Science Teaching). De Waal is director of the Living Links Center at Yerkes and C.H. Candler Professor of Psychology at Emory.

They studied 23 adult chimpanzees that were housed in two separate groups. The chimpanzees viewed several nine-second video clips of other chimpanzees, in both groups, either yawning or doing something else. They yawned 50 percent more frequently in response to seeing members of their group yawn compared to seeing others yawn.

In humans, scientists have identified certain parts of the brain that are activated both when someone experiences pain and when they see someone else experiencing pain. In these experiments, people tend to show more sensitivity for members of the same social group.
The results raise the question of whether contagious yawning among humans shows the same biases: favoring members of the same social group over different social groups.
The authors note one complication: chimpanzees live in small communities where unfamiliar individuals are by definition seen as members of a separate social group. In contrast, humans do not necessarily see strangers as belonging to an "outgroup." For this reason, the in-group/out-group distinction may be more absolute in chimpanzees than in humans. Chimpanzees in the wild are known to be extremely hostile to external groups, which probably adds to the effects found in this study.
The authors say that contagious yawning could be a window into social and emotional connections between individuals, and suggest that insight into barriers to chimpanzee empathy may help break down those barriers for humans.
"Empathy is difficult to measure directly because it is a largely internal response: mimicking the emotional response of another. Contagious yawning allows for a measurement of empathic response that is purely behavioral, and thus can be applied more widely," Campbell writes. "Anyone who wants to increase human empathy towards outsiders should consider that techniques to this effect could be tested out on chimpanzees and other animals."

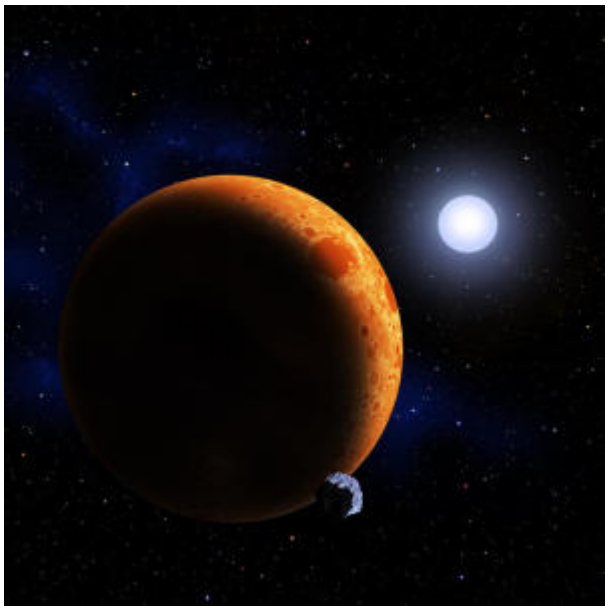
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Emory University**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Matthew W. Campbell, Frans B. M. de Waal. **Ingroup-Outgroup Bias in Contagious Yawning by Chimpanzees Supports Link to Empathy**. *PLoS ONE*, 2011; 6 (4): e18283 DOI: 10.1371/journal.pone.0018283

http://www.sciencedaily.com/releases/2011/04/110406192511.htm

Two Dying Stars to Be Reborn as One



CfA astronomers have found a pair of white dwarf stars orbiting each other once every 39 minutes. In a few million years, they will merge and reignite as a helium-burning star. In this artist's conception, the reborn star is shown with a hypothetical world. (Credit: Image courtesy of Harvard-Smithsonian Center for Astrophysics)

ScienceDaily (Apr. 7, 2011) — White dwarfs are dead stars that pack a Sun's-worth of matter into an Earth-sized ball. Astronomers have just discovered an amazing pair of white dwarfs whirling around each other once every 39 minutes. This is the shortest-period pair of white dwarfs now known. Moreover, in a few million years they will collide and merge to create a single star.

"These stars have already lived a full life. When they merge, they'll essentially be 'reborn' and enjoy a second life," said Smithsonian astronomer Mukremin Kilic (Harvard-Smithsonian Center for Astrophysics), lead author on the paper announcing the discovery.

Out of the 100 billion stars in the Milky Way, only a handful of merging white dwarf systems are known to exist. Most were found by Kilic and his colleagues. The latest discovery will be the first of the group to merge and be reborn.

The newly identified binary star (designated SDSS J010657.39 -- 100003.3) is located about 7,800 light-years away in the constellation Cetus. It consists of two white dwarfs, a visible star and an unseen companion whose presence is betrayed by the visible star's motion around it. The visible white dwarf weighs about 17 percent as much as the Sun, while the second white dwarf weighs 43 per cent as much. Astronomers believe that both are made of helium.

The two white dwarfs orbit each other at a distance of 140,000 miles -- less than the distance from Earth to the Moon. They whirl around at speeds of 270 miles per second (1 million miles per hour), completing one orbit in only 39 minutes.

The fate of these stars is already sealed. Because they wheel around so close to each other, the white dwarfs stir the space-time continuum, creating expanding ripples known as gravitational waves. Those waves carry away orbital energy, causing the stars to spiral closer and closer together. In about 37 million years, they will collide and merge.

When some white dwarfs collide, they explode as a supernova. However, to explode the two combined have to weigh 40 percent more than our Sun. This white dwarf pair isn't heavy enough to go supernova. Instead, they will experience a second life. The merged remnant will begin fusing helium and shine like a normal star once more. We will witness starlight reborn.

This binary white dwarf was discovered as part of a survey program being conducted with the MMT Observatory on Mount Hopkins, Ariz. The survey has uncovered a dozen previously unknown white dwarf pairs. Half of those are merging and might explode as supernovae in the astronomically near future.
The paper on this newfound binary star will be published in the *Monthly Notices of the Royal Astronomical Society*. Kilic's co-authors are Warren Brown and Scott Kenyon (Smithsonian Astrophysical Observatory); Carlos Allende Prieto (Instituto de Astrofisica de Canarias); J. Andrews (Columbia Astrophysics Laboratory); Scot Kleinman (Gemini Observatory); and K. Winget, D. Winget, and J. Hermes (University of Texas at Austin).

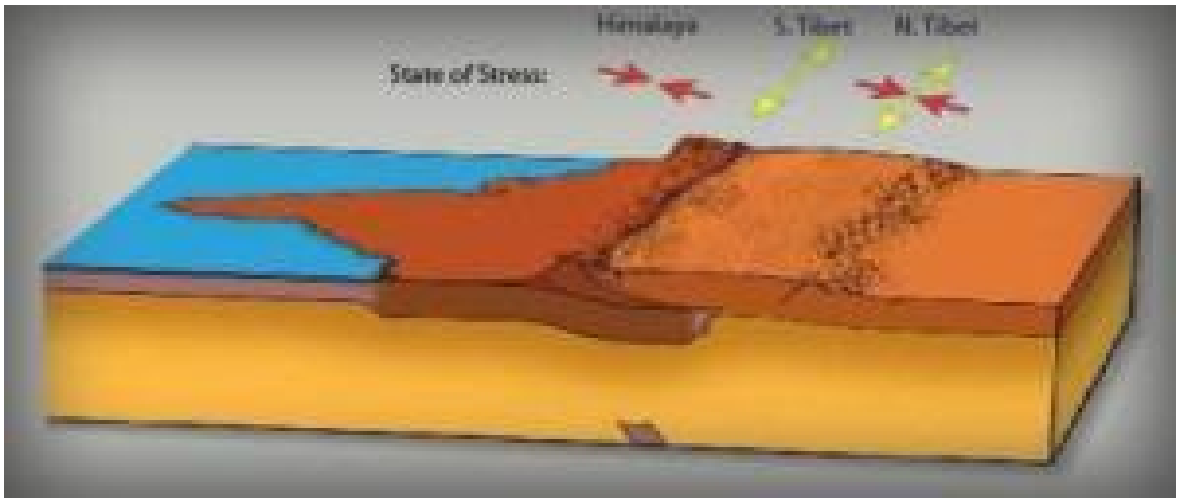
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Harvard-Smithsonian Center for Astrophysics**.

Journal Reference:

1. Mukremin Kilic, Warren R. Brown, S. J. Kenyon, Carlos Allende Prieto, J. Andrews, S. J. Kleinman, K. I. Winget, D. E. Winget, J. J. Hermes. **The Shortest Period Detached Binary White Dwarf System**. *Monthly Notices of the Royal Astronomical Society*, 2011 [link]

http://www.sciencedaily.com/releases/2011/04/110406142349.htm

Strong Indian Crust Thrust Beneath the Tibetan Plateau, New Study Suggests



Earthquake mechanisms and the style of faulting in the Himalaya-Tibet region show that the Himalayan range is under north-south compression, southern Tibet is in east-west extension, and northern Tibet is in both east-west extension and north-south compression. The study shows that this pattern can be explained if the strong Indian crust thrust under southern Tibet is transmitting the north-south push of India to northern Tibet. (Credit: Caltech's Tectonics Observatory)

ScienceDaily (Apr. 6, 2011) — For many years, most scientists studying Tibet have thought that a very hot and very weak lower and middle crust underlies its plateau, flowing like a fluid. Now, a team of researchers at the California Institute of Technology (Caltech) is questioning this long-held belief and proposing that an entirely different mechanism is at play.

"The idea that Tibet is more or less floating on a layer of partially molten crust is accepted in the research community. Our research proposes the opposite view: that there is actually a really strong lower crust that originates in India," says Jean-Philippe Avouac, professor of geology and director of Caltech's Tectonics Observatory.

These insights lead to a better understanding of the processes that have shaped the Himalaya Mountains and Tibet -- the most tectonically active continental area in the world.

Alex Copley, a former postdoctoral scholar with Caltech's Tectonics Observatory, along with Avouac and Brian Wernicke, the Chandler Family Professor of Geology, describe their work in a paper published in the April 7 issue of the journal *Nature*.

Tibet and the surrounding Himalaya Mountains are among the most dynamic regions on the planet. Avouac points out that underground plate collisions, which cause earthquakes and drive up the Himalaya and Tibet, are common geological processes that have happened repeatedly over the course of Earth's history, but are presently happening with a vigor and energy only found in that area.

Even though the elevation is uniform across the Tibetan Plateau, the type of stress seen within the plateau appears to change along a line that stretches east-west across the plateau -- dividing the region into two distinct areas (southern and northern Tibet, for the purposes of this research.)

The researchers propose that a contrast in tectonic style -- primarily east-west extension due to normal faulting in southern Tibet and a combination of north-south compression and east-west extension due to strike-slip faulting in northern Tibet -- is the result of the Indian crust thrusting strongly underneath the southern portion of the Tibetan Plateau and locking into the upper crust. Strike-slip fault surfaces are usually vertical, and the rocks slide horizontally past each other due to pressure build-up, whereas normal faulting occurs where the crust is being pulled apart. They believe that the locked Indian crust alters the state of stress in the southern Tibetan crust, which can explain the contrast in the type of faulting seen between southern Tibet and northern Tibet.

To test their theory, the team performed a series of numerical experiments, assigning different material properties to the Indian crust. The simulations revealed evidence for a strong Indian lower crust that couples,

or locks in, with the upper crust. This suggests that the "channel flow" model proposed by many geophysicists and geologists -- in which a low-viscosity magma oozes through weak zones in the middle crust -- ¬is not correct.

"We have been able to create a model that addresses two long-standing debates," says Copley, who is now a research fellow at the University of Cambridge. "We have constrained the mechanical strength of the Indian crust as it plunges beneath the Tibetan Plateau, and by doing so have explained the variations in the types of earthquakes within the plateau. This is interesting because it gives us new insights into what controls the behavior of large mountain ranges, and the earthquakes that occur within them."

According to Wernicke, the results have motivated the team to think of ways to test further the "weak crust" hypothesis, at least as it might apply to the active tectonic system. "One way we might be able to image an extensive interface at depth is through geodetic studies of southern Tibet, which are ongoing in our research group," he says.

The Gordon and Betty Moore Foundation funded the research in the study. Pembroke College in the University of Cambridge provided additional funding for Copley.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **California Institute of Technology**. The original article was written by Katie Neith.

Journal Reference:

1. Alex Copley, Jean-Philippe Avouac, Brian P. Wernicke. **Evidence for mechanical coupling and strong Indian lower crust beneath southern Tibet**. *Nature*, 2011; 472 (7341): 79 DOI: 10.1038/nature09926

http://www.sciencedaily.com/releases/2011/04/110406131811.htm

Common Dietary Fat and Intestinal Microbes Linked to Heart Disease

Baked goods. Lecithin, and its metabolite, choline, are found in many commercial baked goods, dietary supplements, and even children's vitamins, as well as eggs, liver and other meats, cheese and other dairy products, fish and shellfish. (Credit: iStockphoto)

ScienceDaily (Apr. 6, 2011) — A new pathway has been discovered that links a common dietary lipid and intestinal microflora with an increased risk of heart disease, according to a Cleveland Clinic study published in the latest issue of *Nature*.

The study shows that people who eat a diet containing a common nutrient found in animal products (such as eggs, liver and other meats, cheese and other dairy products, fish, shellfish) are not predisposed to cardiovascular disease solely on their genetic make-up, but rather, how the micro-organisms that live in our digestive tracts metabolize a specific lipid -- phosphatidyl choline (also called lecithin). Lecithin and its metabolite, choline, are also found in many commercial baked goods, dietary supplements, and even children's vitamins.

The study examined clinical data from 1,875 patients who were referred for cardiac evaluation, as well as plasma samples from mice. When fed to mice, lecithin and choline were converted to a heart disease-forming product by the intestinal microbes, which promoted fatty plaque deposits to form within arteries (atherosclerosis); in humans, higher blood levels of choline and the heart disease forming microorganism products are strongly associated with increased cardiovascular disease risk.

"When two people both eat a similar diet but one gets heart disease and the other doesn't, we currently think the cardiac disease develops because of their genetic differences; but our studies show that is only a part of the equation," said Stanley Hazen, M.D., Ph.D., Staff in Lerner Research Institute's Department of Cell Biology and the Heart and Vascular Institute's Department of Cardiovascular Medicine and Section Head of Preventive Cardiology & Rehabilitation at Cleveland Clinic, and senior author of the study. "Actually, differences in gut flora metabolism of the diet from one person to another appear to have a big effect on whether one develops heart disease. Gut flora is a filter for our largest environmental exposure -- what we eat."

Dr. Hazen added, "Another remarkable finding is that choline -- a natural semi-essential vitamin -- when taken in excess, promoted atherosclerotic heart disease. Over the past few years we have seen a huge increase in the addition of choline into multi-vitamins -- even in those marketed to our children -- yet it is this same substance that our study shows the gut flora can convert into something that has a direct, negative impact on heart disease risk by forming an atherosclerosis-causing by-product."

In studies of more than 2,000 subjects altogether, blood levels of three metabolites of the dietary lipid lecithin were shown to strongly predict risk for cardiovascular disease: choline (a B-complex vitamin), trimethylamine N-oxide (TMAO, a product that requires gut flora to be produced and is derived from the choline group of the lipid) and betaine (a metabolite of choline).

"The studies identify TMAO as a blood test that can be used in subjects to see who is especially at risk for cardiac disease, and in need of more strict dietary intervention to lower their cardiac risk," Dr. Hazen said.

Healthy amounts of choline, betaine and TMAO are found in many fruits, vegetables and fish. These three metabolites are commonly marketed as direct-to-consumer supplements, supposedly offering increased brain health, weight loss and/or muscle growth.

These compounds also are commonly used as feed additives for cattle, poultry or fish because they may make muscle grow faster; whether muscle from such livestock have higher levels of these compounds remains unknown.
"Knowing that gut flora generates a pro-atherosclerotic metabolite from a common dietary lipid opens up new opportunities for improved diagnostics, prevention and treatment of heart disease," Dr. Hazen said. "These studies suggest we can intelligently design a heart healthy yogurt or other form of probiotic for preventing heart disease in the future. It also appears there is a need for considering the risk vs. benefits of some commonly used supplements."

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Lerner Research Institute**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Zeneng Wang, Elizabeth Klipfell, Brian J. Bennett, Robert Koeth, Bruce S. Levison, Brandon DuGar, Ariel E. Feldstein, Earl B. Britt, Xiaoming Fu, Yoon-Mi Chung, Yuping Wu, Phil Schauer, Jonathan D. Smith, Hooman Allayee, W. H. Wilson Tang, Joseph A. DiDonato, Aldons J. Lusis, Stanley L. Hazen. **Gut flora metabolism of phosphatidylcholine promotes cardiovascular disease**. *Nature*, 2011; 472 (7341): 57 DOI: 10.1038/nature09922

http://www.sciencedaily.com/releases/2011/04/110406131814.htm

Coffee Drinking in Your Genes? Genetic Variants in Two Genes Linked With Caffeine Intake

Researchers have discovered two genes in which variation affects intake of caffeine, the most widely consumed stimulant in the world. (Credit: iStockphoto/Sergey Galushko)

ScienceDaily (Apr. 6, 2011) — Two genes in which variation affects intake of caffeine, the most widely consumed stimulant in the world, have been discovered. A team of investigators from the National Cancer Institute, Harvard School of Public Health, Brigham and Women's Hospital, and the University of North Carolina at Chapel Hill examined genetic variation across the entire genome of more than 47,000 individuals from the U.S., as described in the open-access journal *PLoS Genetics*.

The genes identified were CYP1A2, which has previously been implicated in the metabolism of caffeine, and AHR, involved in the regulation of CYP1A2. Individuals with the highest-consumption genotype for either gene consumed ~40 mg more caffeine than those with the lowest-consumption genotype, equivalent to the amount of 1/3 cup of caffeinated coffee, or 1 can of cola.

Caffeine is implicated in numerous physiological and medical conditions; it affects sleep patterns, energy levels, mood, and mental and physical performance. The identification of genes that have an impact on daily consumption offers opportunities to better understand these conditions. Further exploration of the identified genetic variants may provide insight into the speed of caffeine metabolism, how long caffeine circulates in the blood, or how strong the physiological effects of consuming a given amount of caffeine are.

Apart from smoking, genetic determinants of lifestyle behaviors have generally not been consistently described. This study is among the first to examine the entire genome for a relationship between genetics and caffeine intake, a lifestyle behavior relevant to over 90% of U.S. adults. The study's success also suggests that additional genetic determinants of dietary and lifestyle behaviors may be identified in the future using a similar genome-based research strategy.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Public Library of Science**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Marilyn C Cornelis, Keri L Monda, Kai Yu, Nina Paynter, Elizabeth M Azzato, Siiri N Bennett, Sonja I Berndt, Eric Boerwinkle, Stephen Chanock, Nilanjan Chatterjee, David Couper, Gary Curhan, Gerardo Heiss, Frank B Hu, David J Hunter, Kevin Jacobs, Majken K Jensen, Peter Kraft, Maria Teresa Landi, Jennifer A Nettleton, Mark P Purdue, Preetha Rajaraman, Eric B Rimm, Lynda M Rose, Nathaniel Rothman, Debra Silverman, Rachael Stolzenberg-Solomon, Amy Subar, Meredith Yeager, Daniel I Chasman, Rob M van Dam, Neil E Caporaso. **Genome-Wide Meta-Analysis Identifies Regions on 7p21 (AHR) and 15q24 (CYP1A2) As Determinants of Habitual Caffeine Consumption**. *PLoS Genetics*, 2011; 7 (4): e1002033 DOI: 10.1371/journal.pgen.1002033

http://www.sciencedaily.com/releases/2011/04/110406091731.htm

Surveillance System to Cut Risk of Space Debris Hitting Satellites

Fragments of disintegrated spacecraft can damage or even destroy operational satellites. (Credit: Image courtesy of Fraunhofer-Gesellschaft)

ScienceDaily (Apr. 7, 2011) — The growing quantity of space debris is a serious threat to satellites and other spacecraft, which risk being damaged or even destroyed. A new European space surveillance system is being developed to ward off the danger of collisions in orbit. Fraunhofer researchers are supplying the receiver for the radar demonstrator system.

Orbital space is like a busy highway, with countless satellites constantly circling Earth and occasional visits by stray asteroids, comets and meteorites. The region is also strewn with debris from human space activities such as burnt-out rocket stages and fragments of disintegrated spacecraft, which are transforming it into an orbiting junk yard. It is estimated that there are currently around 20,000 objects with a minimum diameter of ten centimeters in orbit around Earth, including 15,000 in the low Earth orbit at an altitude of between 200 and 2,000 kilometers. These objects travel at a speed of up to 28,000 kilometers per hour, which means even the smallest particles measuring a centimeter or less in diameter are capable of causing serious damage to any satellite they encounter, or even completely destroying it. Only two years ago, in February 2009, a retired satellite collided with one of the Iridium communication satellites. The International Space Station ISS has to perform four to five evasive maneuvers each year.

In the light of this potentially disastrous situation, the European Space Agency ESA decided to take concrete action by launching a Space Situational Awareness (SSA) program, which runs from 2009 through to the end of 2011, to create the basic framework for a new, European response to this problem. At present, Europe does not possess the necessary high-resolution radar systems capable of tracking all of the smaller items of space debris. For this, the experts have to rely on data supplied by the American Space Surveillance Network. The new European system is to be built up in stages between 2012 and 2019 at locations that have yet to be defined.

ESA has awarded a contract to the Spanish company Indra Espacio to design and construct a radar demonstrator. The company has in turn called on the services of the Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR in Wachtberg to help with the construction of the demonstrator -- a contract valued at 1.4 million euros. The Spanish company will develop the transmitter array, leaving the Fraunhofer scientists to develop the receiver system. The Fraunhofer experts are experienced in the design of radar systems: they already operate the TIRA (Tracking and Imaging Radar) system to detect objects in space. "TIRA is a mechanically steerable system that can be used to obtain images of discrete objects in high resolution. The new surveillance system, by contrast, uses an electronically steerable, inertia-free antenna that can be positioned very quickly. Unlike TIRA, it can observe a large number of objects simultaneously, detecting their position to a high degree of accuracy and sensitivity," says FHR department head Dr. Andreas Brenner.

This is an essential requirement, given the objective of having from 15,000 to 20,000 objects on the radar for at least ten seconds each day. "Our receiver system, that uses a phased-array antenna as the sensor, is capable of capturing radar signals reflected by satellites and space debris in up to eight directions at the same time,"

says Brenner. In its final version, the surveillance radar will be able to detect objects in geostationary orbit at an altitude of approximately 36,000 kilometers above the surface of Earth, but its power will be mainly concentrated on the low Earth orbit at an altitude of between 200 and 2,000 kilometers, where it will be capable of detecting particles of debris measuring down to a few centimeters in diameter. The data this system collects is likely to be of interest to numerous users, including not only European government departments and space agencies but also satellite operators, insurance companies, energy suppliers and telecommunications companies.

The demonstrator is scheduled for delivery to ESA at the end of this year. It will then undergo a one-year test phase. A decision on who will construct the full system has yet to be taken, but Brenner hopes that ESA will recognize the importance of his department's expertise and incorporate its know-how in the final version. In any case, the radar receiver's versatility is undeniable, and the core components are equally suitable for use in other applications such as air traffic control at airports.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Fraunhofer-Gesellschaft**.

http://www.sciencedaily.com/releases/2011/04/110406132020.htm

DNA Stretching: New Technique to Detect Illnesses

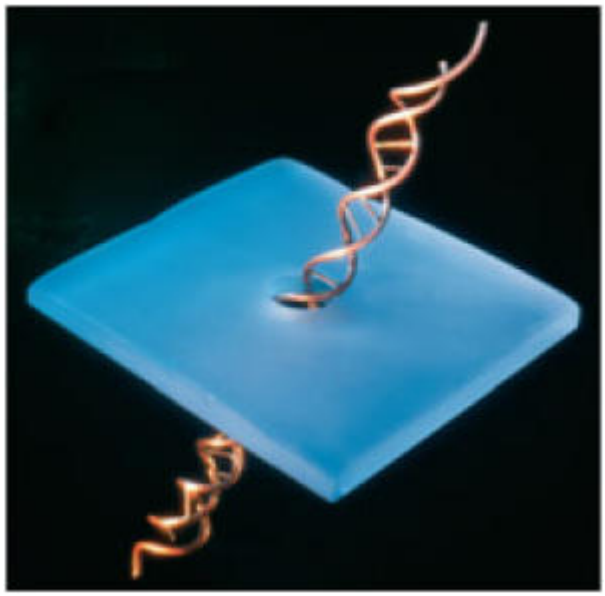


Illustration of DNA stretching technique. (Credit: CIC microGUNE)

ScienceDaily (Apr. 5, 2011) — Scientists are making DNA sequences being passed through nanochannels a thousand times thinner than a human hair to the point that they take on the form of diminutive spaghetti. This is an innovative technique, known as DNA stretching, and is one of the lines of research in which CIC microGUNE is working, and about which they have already published two scientific articles and are shortly to apply for a patent. The technique basically consists of the analysis of a single molecule of DNA, after stretching it, measuring its length and analysing its sequence.

This novel technology could become a simpler and more effective alternative than current methods to analysing DNA and, in this manner, apply it in order to know the predisposition for suffering certain illnesses, diagnosing them or establishing the best therapy once its development is known. The method will also enable other applications, such as the identification of bacteria and viruses, carrying out forensic diagnoses or providing systems for the advancement of therapies for chronic diseases.

In order to stretch DNA molecules, it is necessary to make them pass through channels of tiny dimensions. The Micro- and Nano-engineering Unit at CIC microGUNE, basing itself on known technology such as nanoprinting lithography, has manufactured devices that contain sealed channels of 50 nanometres.

The elements manufactured by CIC microGUNE form part of specific lab-on-a-chip series of devices known as single molecule devices, which enable carrying out a multitude of tasks using a tiny quantity of DNA -- practically the content of a single cell.

"This technology enables determining DNA sequences, detecting genetic alterations that determine specific genes associated with the early detection of illnesses," explained Mr Santos Merino, researcher at CIC microGUNE. This same detection can predict the susceptibility of certain populations of individuals to certain medication (what is known as Pharmacogenetics). The design of these kinds of chips will provide fast, cheap and in-situ (health centre walk-in or out-patient) detection.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Basque Research**.

http://www.sciencedaily.com/releases/2011/04/110405102040.htm

Some People's Climate Beliefs Shift With Weather

People who thought the current day was warmer than usual were more likely to believe in and feel concern about global warming than those who thought the day was unusually cold. (Credit: iStockphoto/Hélène Vallée)

ScienceDaily (Apr. 7, 2011) — Social scientists are struggling with a perplexing earth-science question: as the power of evidence showing humanmade global warming is rising, why do opinion polls suggest public belief in the findings is wavering? Part of the answer may be that some people are too easily swayed by the easiest, most irrational piece of evidence at hand: their own estimation of the day's temperature.

In three separate studies, researchers affiliated with Columbia University's Center for Research on Environmental Decisions (CRED) surveyed about 1,200 people in the United States and Australia, and found that those who thought the current day was warmer than usual were more likely to believe in and feel concern about global warming than those who thought the day was unusually cold. A new paper describing the studies appears in the current issue of the journal Psychological Science.

"Global warming is so complex, it appears some people are ready to be persuaded by whether their own day is warmer or cooler than usual, rather than think about whether the entire world is becoming warmer or cooler," said lead author Ye Li, a postdoctoral researcher at the Columbia Business School's Center for Decision Sciences, which is aligned with CRED. "It is striking that society has spent so much money, time and effort educating people about this issue, yet people are still so easily influenced." The study says that "these results join a growing body of work show that irrelevant environmental information, such as the current weather, can affect judgments. … By way of analogy, when asked about the state of the national economy, someone might look at the amount of money in his or her wallet, a factor with only trivial relevance."

Ongoing studies by other researchers have already provided strong evidence that opinions on climate and other issues can hinge on factors unrelated to scientific observations. Most pointedly, repeated polls have shown that voters identifying themselves as political liberals or Democrats are far more likely to believe in human-influenced climate change than those who identify themselves as conservatives or Republicans. Women believe more than men, and younger people more than older ones. Other, yet-to-be published studies at four other universities have looked at the effects of actual temperature -- either the natural one outside, or within a room manipulated by researchers -- and show that real-time thermometer readings can affect people's beliefs as well. These other studies involve researchers at New York University, Temple University, the University of Chicago and the University of California, Berkeley.

In the current paper, respondents were fairly good at knowing if it was unusually hot or cold--perceptions correlated with reality three quarters of the time -- and that the perception exerted a powerful control on their attitude. As expected, politics, gender and age all had the predicted influences: for instance, on the researchers' 1-to-4 scale of belief in global warming, Democrats were 1.5 points higher than Republicans. On the whole though, after controlling for the other factors, the researchers found that perceived temperatures still had nearly two-thirds the power as political belief, and six times the power as gender, to push someone one way or the other a notch along the scale. (The coming NYU/Temple study suggests that those with no strong political beliefs and lower education are the most easily swayed.)

In one of the studies described in the paper, the researchers tried to test the earnestness of the responses by seeing how many of those getting paid $8 for the survey were willing to donate to a real-life charity, Clean Air-Cool Planet. The correlation was strong; those who said it was warmer donated an average of about $2; those who felt it was cooler gave an average of 48 cents.

The researchers say the study not only points to how individuals' beliefs can change literally with the wind. Li says it is possible that weather may have influenced recent large-scale public opinion polls showing declining faith in climate science. Administered at different times, future ones might turn out differently, he said. These polls, he pointed out, include the national elections, which always take place in November, when things are getting chilly and thus may be empowering conservative forces at a time when climate has become a far more contentious issue than in the past. (Some politicians subsequently played up the heavy snows and cold of winter 2009-2010 as showing global warming was a hoax -- even though scientists pointed out that such weather was probably controlled by short-term atmospheric mechanisms, and consistent with long-term warming.) "I'm not sure I'd say that people are manipulated by the weather. But for some percentage of people, it's certainly pushing them around." said Li.

The other authors are Eric J. Johnson, co-director of the Center for Decision Sciences; and Lisa Zaval, a Columbia graduate student in psychology.

Story Source:

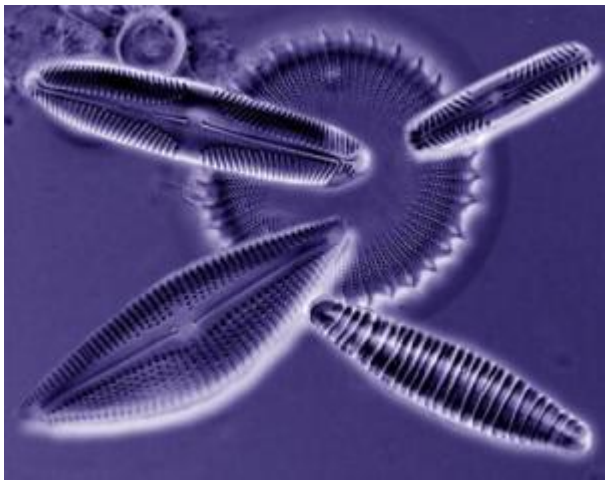
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **The Earth Institute at Columbia University**.

Journal Reference:

1. Y. Li, E. J. Johnson, L. Zaval. **Local Warming: Daily Temperature Change Influences Belief in Global Warming**. *Psychological Science*, 2011; DOI: 10.1177/0956797611400913

http://www.sciencedaily.com/releases/2011/04/110406161039.htm

Biodiversity Improves Water Quality in Streams Through a Division of Labor



Streams contain a variety of types of algae that remove pollutants from the water. This microscope image shows several species of algae similar to those used in the University of Michigan biodiversity study. (Credit: Danuta Bennett)

ScienceDaily (Apr. 7, 2011) — Biologically diverse streams are better at cleaning up pollutants than less rich waterways, and a University of Michigan ecologist says he has uncovered the long-sought mechanism that explains why this is so.

Bradley Cardinale used 150 miniature model streams, which use recirculating water in flumes to mimic the variety of flow conditions found in natural streams. He grew between one and eight species of algae in each of the mini-streams, then measured each algae community's ability to soak up nitrate, a nitrogen compound that is a nutrient pollutant of global concern.

He found that nitrate uptake increased linearly with species richness. On average, the eight-species mix removed nitrate 4.5 times faster than a single species of algae grown alone. Cardinale reports his findings in the April 7 edition of the journal *Nature*.

"The primary implication of this paper is that naturally diverse habitats are pretty good at cleaning up the pollutants we dump into the environment, and loss of biodiversity through species extinctions could be compromising the ability of the planet to clean up after us," said Cardinale, an assistant professor at the U-M School of Natural Resources and Environment.

Why are more diverse streams better pollutant filters? Niche partitioning, Cardinale said.

In the stream experiments, each algae species was best adapted to a particular habitat in the stream and gravitated to that location -- its unique ecological niche. As more algae species were added, more of the available habitats were used, and the stream became a bigger, more absorbent sponge for nitrate uptake and storage.

Think of niche partitioning as a division of labor among specialist organisms.

"People as far back as Darwin have argued that species should have unique niches and, as a result, we should see a division of labor in the environment," Cardinale said. "But demonstrating that directly has proven very difficult.

"And so one of the primary contributions of this study is that I was able to nail the mechanism and show exactly why streams that have more species are better at removing these nutrient pollutants from the water," he said.

In the experiments, the channels inside each flume were lined with a continuous slab of molded plastic. The plastic provided a growth surface for the algae, and variations in the shape of the slab's surface created a variety of water features -- riffles, pools and eddies, for example -- found in real streams.

Evidence supporting the finding that niche partitioning was responsible for the results includes the fact that different morphological forms of algae dominated unique and complementary habitats in the streams, as predicted by ecological theory. High-velocity habitats were dominated by small, single-celled diatoms that

latch onto the streambed in a way that is resistant to displacement by shear. Low-velocity habitats were dominated by large, filamentous algae that are susceptible to shear.
When the streams were simplified so that they contained just one habitat type, the effects of diversity on nitrate uptake disappeared, confirming that niche differences among species were responsible for the results. The algal species used in the study included eight forms of diatom and green algae that are among the most widespread and abundant species in North American streams. The experiment was performed in the stream flume facility at the University of California, Santa Barbara.
Nitrate is an ingredient in many fertilizers and is found in surface runoff from agricultural land that makes its way into streams, lakes and coastal zones. It is a leading cause of degraded water quality worldwide.
"One of the obvious implications of this study is that if we want to enhance water quality in places like the Chesapeake Bay watershed or around the Great Lakes, then conserving natural biodiversity in our streams will have the added benefit of helping to clean up these larger bodies of water," Cardinale said.
The work was funded by grants from the National Science Foundation.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Michigan**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Bradley J. Cardinale. **Biodiversity improves water quality through niche partitioning**. *Nature*, 2011; 472 (7341): 86 DOI: 10.1038/nature09904

http://www.sciencedaily.com/releases/2011/04/110406131807.htm

Micro Aircraft Improves Avionic Systems and Sensors

Myriad sensors and systems provide modern aircraft with data for flight control. But a bird's eye perspective is also of great benefit when measuring pollutants, searching for missing persons and even in archaeological research. Postgraduate students at the Technische Universitaet Muenchen have now developed an unmanned aerial vehicle that can be deployed for many such tasks. It successfully completed its maiden flight yesterday. Pilot Christian Roessler is shown here with IMPULLS after the successful maiden flight. (Credit: Ulrich Benz)

ScienceDaily (Apr. 7, 2011) — A novel test aircraft of the TU Muenchen successfully completed its maiden flight April 6 at the airfield of the MFC Red Baron near Heimstetten. The micro aircraft christened "IMPULLS" (Innovative Modular Payload UAV -- TUM LLS) will facilitate testing aviation sensors and systems. It was jointly developed by postgraduate students at the Institute of Aircraft Design and the Institute of Flight System Dynamics in Garching. Propelled by a compact electric motor, the aircraft flies quietly and free of emissions.

A particularly important feature of the novel design is its modular construction. This allows the scientists to install a wide variety of systems to be tested under flight conditions. This also applies to components of the electric propulsion unit, since the scientists intend to use IMPULLS to investigate possible implementations of electric and hybrid propulsion systems in aircraft.

UAVs like IMPULLS are ideal for measuring atmospheric pollution, for aerial geo-surveying or monitoring the environment and infrastructures from above. A further field of deployment is information collection in emergencies and dangerous situations. Appropriately equipped UAVs can also be deployed in adverse weather conditions or hazardous situations that would pose an unreasonable risk to pilots.

"Thanks to advances in miniaturization and improved performance of sensor and avionics systems, we can use IMPULLS as a cornerstone for these kind of developments," says Professor Mirko Hornung, chair of the Institute of Aircraft Design. Deriving and understanding the associated business models and ranges of services are also topics that can be investigated using the IMPULLS platform.

IMPULLS has a wingspan of 5 meters and an empty weight of 20 kilograms. It is propelled by a two-kilowatt electric motor. The UAV can carry a payload of 10 kilograms and fly non-stop for up to 75 minutes. As in commercial aircraft, essential safety-relevant components are designed redundantly.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Technische Universitaet Muenchen**, via EurekAlert!, a service of AAAS.

http://www.sciencedaily.com/releases/2011/04/110406123023.htm

Treating Newborn Horses: A Unique Form of Pediatrics

"Because our patients can't talk to us, we have to figure out what's wrong with them based on physical examination and testing and histories given by their owners," said Pamela Wilkins, a professor of equine internal medicine and emergency/critical care at the University of Illinois and author of a new paper on equine neonatal intensive care. (Credit: L. Brian Stauffer)

ScienceDaily (Apr. 7, 2011) — Like any other newborn, the neonatal horse can be a challenging patient. Its immune system is still under construction, its blood chemistry can vary wildly, and -- like most infants -- it wants to stay close to mom.

These factors are magnified in the critically ill foal, said Pamela Wilkins, a professor of equine internal medicine and emergency/critical care at the University of Illinois and the author of a new paper on equine neonatal intensive care.

The paper, in *Clinical Laboratory Medicine*, offers guidance to the large-animal veterinarian and demonstrates the very real challenges of the job.

Sickness can play havoc with a foal's blood chemistry, Wilkins said. Teasing out the causes of these changes requires that the veterinarian first understand what is normal in a newborn horse, and then how it can go wrong. To help address current gaps in knowledge, Wilkins regularly conducts blood tests or other tests, such as X-rays and CT scans, on healthy foals to determine how their body chemistry or physiology differ from that of an adult horse -- or from that of a sick foal.

"Roughly 3 to 7 percent of newborn foals are going to have some kind of significant health issue in the first month of life," Wilkins said.

"And because our patients can't talk to us, we have to figure out what's wrong with them based on physical examination and testing and histories given by their owners."

The paper also offers guidance in the use of portable "point of care" devices to measure and monitor a sick foal's changing health status. Such tools can offer immediate results in the field and cut costs associated with care. But the practitioner needs to know how use each device and interpret the results, Wilkins said.

"For example, foals with severe infections can have a very, very low or a very high glucose level," she said. Low blood glucose could be the result of the foal not taking in enough nutrients from its mother. Or the animal may not be able to make use of the glucose that is already stored as glycogen in its body. It's the practitioner's job to find out what's going on, she said.

To do that, veterinarians must understand the normal fluctuations in levels of glucose and other "biomarkers" of health or disease, Wilkins said.

"Blood glucose levels are going to be different between the normal, healthy adult horse and the healthy foal," she said. "And they're going to be different at different stages of the foal's life." Hormones, immune cells, red blood cells, protein levels, enzymes and electrolytes all vary between the adult and the infant horse, Wilkins said. And many of these markers change as the foal matures and grows.

The challenges of treating a sick foal doesn't end there, she said. A horse, even a foal, is a big, precocious animal.

"Horses are a prey species, so they have to be able to get on their feet and run pretty quickly after birth," she said. "The older and slower I get, the harder it is to approach them. You spend a lot of time on your knees

dealing with them, and they can kick. I get bruises all over my body during foaling season and I have no idea where they're from because I'm focused on what I'm doing."
Add a very protective mother to the equation, and the task gets even trickier.
"The mom needs to be there," Wilkins said. "She gets really upset if she's not."
So when a foal comes into the hospital for critical care, the mother comes too. And like any mother with a sick baby, she hovers.
"Figuring out a way to keep mom from pulling the IV lines out and getting upset when you're between her and the baby, that takes some doing," Wilkins said. "The mothers don't sleep; they don't lie down; they don't rest. They're on their feet with their heads hanging over their babies most of the time. So it's tough for them."
If a foal needs surgery, the medical staff will sedate the mom until the foal is back at her side.
Wilkins' patients may be the progeny of racehorses or performance horses, but many are also just people's pets, she said. The cost of care can be high, so owners with a strong economic or emotional incentive are most likely to bring a critically ill foal to the hospital.
Despite the many challenges, Wilkins loves the work. "Foals are just wonderful, wonderful creatures," she said. "I can't imagine working with anything else in my life."

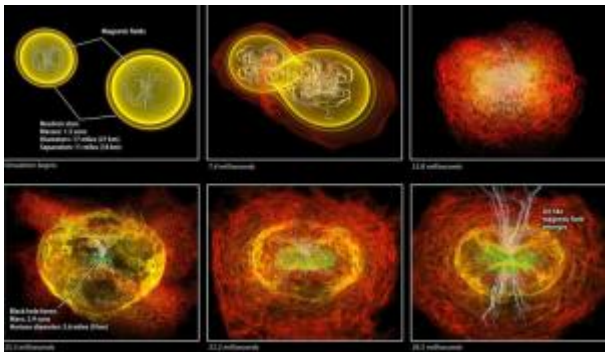
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Illinois at Urbana-Champaign**.

Journal Reference:

1. Pamela A. Wilkins. **The Equine Neonatal Intensive Care Laboratory: Point-of-Care Testing**. *Clinics in Laboratory Medicine*, 2011; 31 (1): 125 DOI: 10.1016/j.cll.2010.11.001

http://www.sciencedaily.com/releases/2011/04/110406123021.htm

Cause of Short Gamma-Ray Bursts Determined



These images show the merger of two neutron stars recently simulated using a new supercomputer model. Redder colors indicate lower densities. Green and white ribbons and lines represent magnetic fields. The orbiting neutron stars rapidly lose energy by emitting gravitational waves and merge after about three orbits, or in less than 8 milliseconds. The merger amplifies and scrambles the merged magnetic field. A black hole forms and the magnetic field becomes more organized, eventually producing structures capable of supporting the jets that power short gamma-ray bursts. (Credit: NASA/AEI/ZIB/M. Koppitz and L. Rezzolla)

ScienceDaily (Apr. 7, 2011) — A new supercomputer simulation shows the collision of two neutron stars can naturally produce the magnetic structures thought to power the high-speed particle jets associated with short gamma-ray bursts (GRBs). The study provides the most detailed glimpse of the forces driving some of the universe's most energetic explosions.

The state-of-the-art simulation ran for nearly seven weeks on the Damiana computer cluster at the Albert Einstein Institute (AEI) in Potsdam, Germany. It traces events that unfold over 35 milliseconds -- about three times faster than the blink of an eye.

GRBs are among the brightest events known, emitting as much energy in a few seconds as our entire galaxy does in a year. Most of this emission comes in the form of gamma rays, the highest-energy form of light.

"For the first time, we've managed to run the simulation well past the merger and the formation of the black hole," said Chryssa Kouveliotou, a co-author of the study at NASA's Marshall Space Flight Center in Huntsville, Ala. "This is by far the longest simulation of this process, and only on sufficiently long timescales does the magnetic field grow and reorganize itself from a chaotic structure into something resembling a jet."

GRBs longer than two seconds are the most common type and are widely thought to be triggered by the collapse of a massive star into a black hole. As matter falls toward the black hole, some of it forms jets in the opposite direction that move near the speed of light. These jets bore through the collapsing star along its rotational axis and produce a blast of gamma rays after they emerge. Understanding short GRBs, which fade quickly, proved more elusive. Astronomers had difficulty obtaining precise positions for follow-up studies. That began to change in 2004, when NASA's Swift satellite began rapidly locating bursts and alerting astronomers where to look.

"For more than two decades, the leading model of short GRBs was the merger of two neutron stars," said co-author Bruno Giacomazzo at the University of Maryland and NASA's Goddard Space Flight Center in Greenbelt, Md. "Only now can we show that the merger of neutron stars actually produces an ultrastrong magnetic field structured like the jets needed for a GRB."

A neutron star is the compressed core left behind when a star weighing less than about 30 times the sun's mass explodes as a supernova. Its matter reaches densities that cannot be reproduced on Earth -- a single spoonful outweighs the Himalayan Mountains.

The simulation began with a pair of magnetized neutron stars orbiting just 11 miles apart. Each star packed 1.5 times the mass of the sun into a sphere just 17 miles across and generated a magnetic field about a trillion times stronger than the sun's.

In 15 milliseconds, the two neutron stars crashed, merged and transformed into a rapidly spinning black hole weighing 2.9 suns. The edge of the black hole, known as its event horizon, spanned less than six miles. A swirling chaos of superdense matter with temperatures exceeding 18 billion degrees Fahrenheit surrounded

the newborn black hole. The merger amplified the strength of the combined magnetic field, but it also scrambled it into disarray.

Over the next 11 milliseconds, gas swirling close to the speed of light continued to amplify the magnetic field, which ultimately became a thousand times stronger than the neutron stars' original fields. At the same time, the field became more organized and gradually formed a pair of outwardly directed funnels along the black hole's rotational axis.

This is exactly the configuration needed to power the jets of ultrafast particles that produce a short gamma-ray burst. Neither of the magnetic funnels was filled with high-speed matter when the simulation ended, but earlier studies have shown that jet formation can occur under these conditions.

"By solving Einstein's relativity equations as never before and letting nature take its course, we've lifted the veil on short GRBs and revealed what could be their central engine," said Luciano Rezzolla, the study's lead author at AEI. "This is a long-awaited result. Now it appears that neutron star mergers inevitably produce aligned jet-like structures in an ultrastrong magnetic field."

The study is available online and will appear in the May 1 edition of The Astrophysical Journal Letters.

The authors note the ultimate proof of the merger model will have to await the detection of gravitational waves -- ripples in the fabric of space-time predicted by relativity. Merging neutron stars are expected to be prominent sources, so the researchers also computed what the model's gravitational-wave signal would look like. Observatories around the world are searching for gravitational waves, so far without success because the signals are so faint.

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http://www.sciencedaily.com/releases/2011/04/110407132618.htm

Cave Fish Insomniacs: Fishes That Sleep Less Point to Genetic Basis for Slumber, Biologists Find

Cave fish sleep significantly less than their surface counterparts do, a finding by NYU biologists that reveals the genetics involved in sleep patterns and disorders. Their study may shed light on how genetic makeup contributes to sleep variation and disruption in humans. (Credit: Image courtesy of New York University)

ScienceDaily (Apr. 7, 2011) — Cave life is known to favor the evolution of a variety of traits, including blindness and loss of eyes, loss of pigmentation, and changes in metabolism and feeding behavior. Now researchers have added sleeplessness to that list.

Cave fish sleep significantly less than their surface counterparts, a finding by New York University biologists that reveals the genes involved in sleep patterns and disorders. Their study, which appears in the journal *Current Biology*, may shed light on how genetic makeup contributes to sleep variation and disruption in humans.

The study's authors were Erik Duboué, an NYU graduate student, Alex Keene, an NYU post-doctoral fellow, and Richard Borowsky, a professor in NYU's Department of Biology.

They examined surface fish in the species *Astyanax mexicanus* and three cave fish populations, Pachón, Tinaja and Molino, all of which inhabit northeast Mexico. While surface and cave fish have different physical appearances and behaviors -- or phenotypes -- brought about by evolutionary change, the researchers sought to determine whether the sleep patterns of cave fish also changed as they adapted to cave life.

To do so, they examined sleep patterns of both the surface and cave fish using two methods. In one, they determined that fish inactive for 60 seconds or more were sleeping. This conclusion was confirmed by tapping on the tank -- fish inactive for this length of time were slow to respond to the tapping, a behavior consistent with being awoken from sleep. In the second, the researchers deprived the fish sleep as a way of inducing subsequent sleep behavior. When animals are deprived the chance to sleep, there is a rebound effect, so at the next opportunity, they sleep for longer than normal periods to make up for the deprivation. The researchers tested this rebound effect by disturbing the sleep of fish all night by moving their containers once a minute. When observed the next day, they slept significantly increased amounts of time.

Using these methods, the researchers found that, over a 24-hour period, surface fish slept an average of over 800 minutes while cavefish slept an average of between 110 to 250 minutes.

The researchers then sought to determine if genetics played a role in the varying sleep behaviors. To do this, they bred cave and surface fish and examined the sleep patterns of these hybrids. Their results showed that these hybrid fish nearly matched the sleep patterns of the cave fish, rather than those of the surface fish, demonstrating that cave fish carry a dominant gene for less sleep.

"In some ways, the sleep phenotypes of cave fish are similar to those of humans with sleep disorders," explained Borowsky. "They go to sleep, but only for relatively short periods, then they awaken and remain awake for relatively long periods."
"The next job is to identify the genes which are responsible for sleep modification in the cave fish. They would be good candidates for the genes responsible for insomnia and other sleep disorders in humans," he added.
The study was funded by grant from the National Science Foundation.

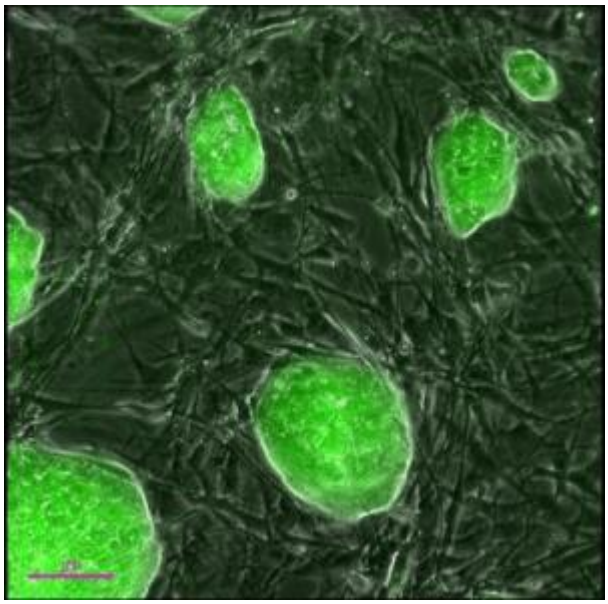
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **New York University**.

Journal Reference:

1. Erik R. Duboué, Alex C. Keene, Richard L. Borowsky. **Evolutionary Convergence on Sleep Loss in Cavefish Populations**. *Current Biology*, 07 April 2011 DOI: 10.1016/j.cub.2011.03.020

http://www.sciencedaily.com/releases/2011/04/110407121322.htm

New Highly Efficient Way to Make Reprogrammed Stem Cells



These are mouse iPSCs generated using the microRNA method pioneered by the Morrisey Lab. The green fluorescence reveals expression of the Oct4 gene, which is a marker of pluripotent stem cells. (Credit: Edward Morrisey, PhD; University of Pennsylvania School of Medicine)

ScienceDaily (Apr. 7, 2011) — Researchers at the University of Pennsylvania School of Medicine have devised a totally new and far more efficient way of generating induced pluripotent stem cells (iPSCs), immature cells that are able to develop into several different types of cells or tissues in the body. The researchers used fibroblast cells, which are easily obtained from skin biopsies, and could be used to generate patient-specific iPSCs for drug screening and tissue regeneration.

iPSCs are typically generated from adult non-reproductive cells by expressing four different genes called transcription factors. The generation of iPSCs was first reported in 2006 by Shinya Yamanaka, and multiple groups have since reported the ability to generate these cells using some variations on the same four transcription factors.

The promise of this line of research is to one day efficiently generate patient-specific stem cells in order to study human disease as well as create a cellular "storehouse" to regenerate a person's own cells, for example heart or liver cells. Despite this promise, generation of iPSCs is hampered by low efficiency, especially when using human cells.

"It's a game changer," says Edward Morrisey, PhD, professor in the Departments of Medicine and Cell and Developmental Biology and Scientific Director at the Penn Institute for Regenerative Medicine. "This is the first time we've been able to make induced pluripotent stem cells without the four transcription factors and increase the efficiency by 100-fold." Morrisey led the study published this week in *Cell Stem Cell*.

"Generating induced pluripotent stem cells efficiently is paramount for their potential therapeutic use," noted James Kiley, PhD, director of the National Heart, Lung, and Blood Institute's Division of Lung Diseases. "This novel study is an important step forward in that direction and it will also advance research on stem cell biology in general."

Before this procedure, which uses microRNAs instead of the four key transcription factor genes, for every 100,000 adult cells re-programmed, researchers were able to get a small handful of iPSCs, usually less than 20. Using the microRNA-mediated method, they have been able to generate approximately 10,000 induced pluripotent stem cells from every 100,000 adult human cells that they start with. MicroRNAs (miRNAs) are short RNA molecules that bind to complementary sequences on messenger RNAs to silence gene expression. The Morrisey lab discovered this new approach through studies focusing on the role of microRNAs in lung development. This lab was working on a microRNA cluster called miR302/367, which plays an important role

in lung endoderm progenitor development. This same microRNA cluster was reported to be expressed at high levels in embryonic stem cells, and iPSCs and microRNAs have been shown to alter cell phenotypes.
The investigators performed a simple experiment and expressed the microRNAs in mouse fibroblasts and were surprised to observe colonies that looked just like iPSCs. "We were very surprised that this worked the very first time we did the experiment," says Morrisey. "We were also surprised that it worked much more efficiently than the transcription factor approach pioneered by Dr. Yamanaka."
Since microRNAs act as repressors of protein expression, it seems likely that they repress the repressors of the four transcription factors and other factors important for maintaining the pluripotent-stem-cell state. However, exactly how the miRNAs work differently compared to the transcription factors in creating iPSCs will require further investigation.
The iPSCs generated by the microRNA method in the Morrisey lab are able to generate most, if not all, tissues in the developing mouse, including germ cells, eggs and sperm. The group is currently working with several collaborators to redifferentiate these iPSCs into cardiomyocytes, hematopoietic cells, and liver hepatocytes.
"We think this method will be very valuable in generating iPSCs from patient samples in a high-throughput manner" says Morrisey. microRNAs can also be introduced into cells using synthetically generated versions of miRNAs called mimics or precursors. These mimics can be easily introduced into cells at high levels, which should allow for a non-genetic method for efficiently generating iPSCs.
"The upshot is that we hope to be able to produce synthetic microRNAs to transform adult cells into induced pluripotent stem cells, which could eventually then be redifferentiated into other cell types, for example, liver, heart muscle or nerve cells" says Morrisey.
Other authors of the study include Frederick Anokye-Danso, Chinmay M. Trivedi, and Jonathan A. Epstein, all from Penn. These studies were funded by the National Heart, Lung and Blood Institute Progenitor Cell Biology Consortium and Division of Lung Disease and the American Heart Association Jon DeHaan Myogenesis Center Award.

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The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Pennsylvania School of Medicine**.

Journal Reference:

1. Frederick Anokye-Danso, Chinmay M. Trivedi, Denise Juhr, Mudit Gupta, Zheng Cui, Ying Tian, Yuzhen Zhang, Wenli Yang, Peter J. Gruber, Jonathan A. Epstein et al. **Highly Efficient miRNA-Mediated Reprogramming of Mouse and Human Somatic Cells to Pluripotency**. *Cell Stem Cell*, Volume 8, Issue 4, 376-388, 8 April 2011 DOI: 10.1016/j.stem.2011.03.001

http://www.sciencedaily.com/releases/2011/04/110407121334.htm

Personal Touch: Hearing a Heartbeat Has the Same Effect as Looking Each Other in the Eye

Hearing the heartbeat of someone you are talking to gives the same feeling of personal contact as looking each other in the eye, according to new research. The research focuses on improving human contact when using digital communication channels. (Credit: iStockphoto/Henrik Jonsson)

ScienceDaily (Apr. 7, 2011) — Hearing the heartbeat of someone you are talking to gives the same feeling of personal contact as looking each other in the eye. This is the remarkable conclusion of research at Eindhoven University of Technology (TU/e) in partnership with Stanford University and Philips Research. The research focuses on improving human contact when using digital communication channels.

Distance

In the research, performed by doctoral candidate Joris Janssen of TU/e, the test subjects were placed in an immersive virtual environment with a 'virtual' partner. When the test subjects heard a natural heartbeat belonging to their partner, they automatically kept a greater distance in the same way as people do in everyday situations. The test subjects also indicated that they experienced closer contact with their virtual discussion partner because of the heartbeat. The effect was found to be just as great as looking each other in the eye. This effect was measured in virtual reality (VR). Earlier research shows that VR findings of this kind are also applicable to 'real life'.

Loneliness

The aim of the research is to find ways to improve the quality of digital communication. In other words: that users experience the communication as more personal, with the underlying goals of combating loneliness and improving wellbeing and health. Seeing each other is an important factor, and being aware of the other person's heartbeat strengthens the feeling of personal contact still further. This doesn't have to be through sound, Joris Janssen explains. The heartbeat can also be transmitted by a beating (tactile) feeling, for example by wearing a special ring, which has the same effect. So he doesn't expect heartbeats to actually be heard during conversations in the future.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Eindhoven University of Technology**.

Journal Reference:

1. Joris H. Janssen, Jeremy N. Bailenson, Wijnand A. IJsselsteijn, Joyce H.D.M. Westerink. **Intimate Heartbeats: Opportunities for Affective Communication Technology**. *IEEE Transactions on Affective Computing*, 2010; 1 (2): 72 DOI: 10.1109/T-AFFC.2010.13

http://www.sciencedaily.com/releases/2011/04/110407093118.htm

If Plants Generate Magnetic Fields, They're Not Saying

A titan arum nicknamed "Trudy" is fully opened after flowering in June 2009 in the UC Botanical Garden. Two sensors of a magnetomer are visible to the lower left. (Credit: Eric Corsini, UC Berkeley)

ScienceDaily (Apr. 7, 2011) — Searching for magnetic fields produced by plants may sound as wacky as trying to prove the existence of telekinesis or extrasensory perception, but physicists at the University of California, Berkeley, are seriously looking for biomagnetism in plants using some of the most sensitive magnetic detectors available.

In an article that appeared this week in the *Journal of Applied Physics*, the UC Berkeley scientists describe the instruments they used to look for minuscule magnetic fields around a titan arum -- the world's largest flower -- during its brief bloom, the interference from local BART trains and traffic that bedeviled the experiment, and their ultimate failure to detect a magnetic field.

They established, however, that the plant generated no magnetic field greater than a millionth the strength of the magnetic field surrounding us here on Earth.

Why look for biomagnetism in plants?

"There is a lot of activity now by scientists studying biomagnetism in animals, but not in plants," said Dmitry Budker, UC Berkeley professor of physics. "It is an obvious gap in science right now."

In animals, for example, activity in the heart and brain produce tiny magnetic fields that can be measured by sensitive magnetometers.

"We feel like this is a first step in an interesting direction that we would like to pursue," he added.

Budker spends most of his time developing extremely sensitive magnetic field detectors -- in particular, atomic magnetometers based on nonlinear magnetooptical rotation (NMOR). These devices can measure

magnetic fields as low as 10 femtotesla, nearly a billion times lower than Earth's magnetic field at the surface, which is usually between 20 and 50 microtesla, depending on the location.
Magnetic noise in the laboratory initially led the Budker team to the University of California Botanical Garden, which provided an isolated space for them to test their magnetometers. There, the researchers, including graduate student Eric Corsini, encountered the garden's famed titan arum (Amorphophallus titanium), a plant that every few years sends up a tall, thick stalk covered with thousands of small flowers enveloped by one large, flower-like calyx. During its brief flowering, the plant gives off a powerful odor of rotting flesh to attract the carrion beetles and flesh flies that pollinate it.
"This giant, skirt-like thing opens fairly quickly, over an hour or two, and the plant starts to heat up and get really warm, and then gives off this odor that is strongest for the first 12 hours," said Paul Licht, director of the UC Botanical Garden. "By the end of 24 hours, all the real action is over; the pollination cycle has a very brief window to succeed."
Because magnetic fields are created by moving electrical charges, such as a current of electrons, the researchers thought that rapid processes in the plant during the rapid heating might involve flowing ions that would create a magnetic field. In the titan arum, the rapid heating raises the plant temperature as high as 20 to 30 Celsius (70-85 degrees Fahrenheit).
"In principle, there shouldn't be a fundamental difference between animals and plants in this respect, but as for which plants might produce the highest magnetic fields, that is a question for biologists," Budker said.
In June 2009, one of the garden's arums was ready to erupt, so the Budker group, headed by Corsini, set up a sensitive, commercial magnetometer next to the plant in a hothouse and monitored it continually. During the day, visitors entering the hothouse generated magnetic signals, and the BART trains several miles away created .05 microtesla signals periodically.
"We were most disappointed in not being able to put a tighter tolerance on our measurement, because we couldn't find a way to cancel out the local ambient magnetic field noise," Corsini said.
He and Budker expect that they can increase their sensitivity by a factor of 10 or 100, however.
"We haven't given up," Corsini said. "The next step is to see whether we can get hold of a smaller plant and perhaps shield it from outside magnetic fields far from public viewing. So far, biomagnetism is a fun side project for me, but if we were to see something …."
"The hope is that, next time one flowers, we're going to get it," Licht said.
People who want their own titan arum can purchase offspring, some now three to four feet high, at the botanical garden. While these plants make fascinating and easy houseplants, however, the owner should be prepared to move out of the house for a night when the plant ultimately flowers, Licht said.
The work was part of a project funded by the Office of Naval Research and the U.S. Department of Energy through the Lawrence Berkeley National Laboratory.
Coauthors with Budker, Corsini and Licht are Victor Acosta, Nicolas Baddour and Brian Patton of UC Berkeley's physics department; James Higbie, a former UC Berkeley doctoral student now at Bucknell University; Brian Lester of the Department of Physics at the California Institute of Technology, who was a summer visitor at the time of the experiments; and Mark Prouty of Geometrics Inc. in San Jose, maker of the magnetometer employed in the study.

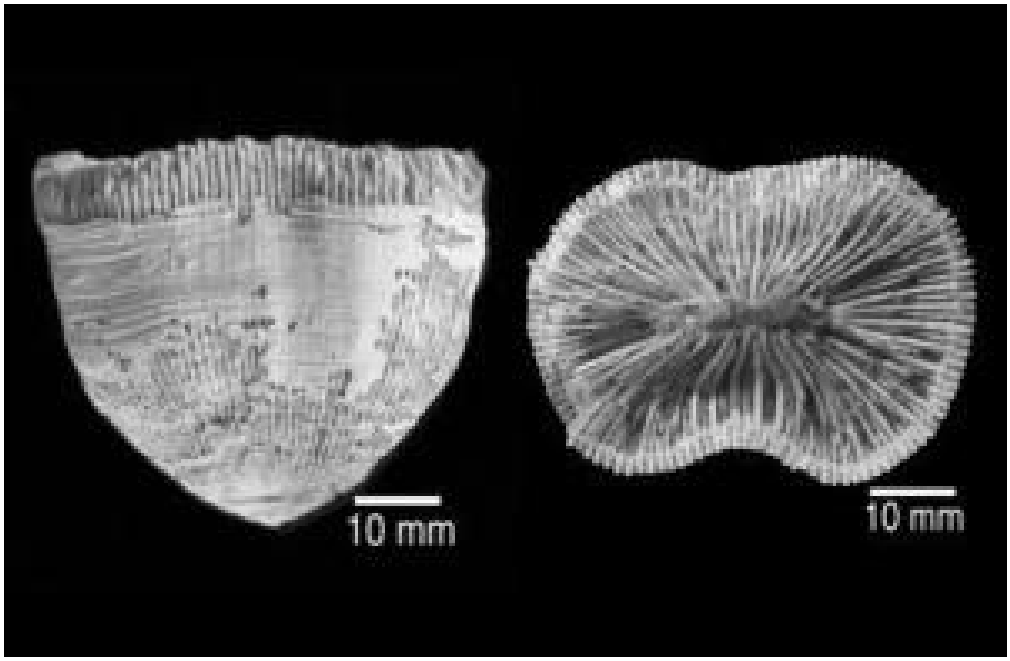
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of California - Berkeley**. The original article was written by Robert Sanders.

Journal Reference:

1. Eric Corsini, Victor Acosta, Nicolas Baddour, James Higbie, Brian Lester, Paul Licht, Brian Patton, Mark Prouty, Dmitry Budker. **Search for plant biomagnetism with a sensitive atomic magnetometer**. *Journal of Applied Physics*, 2011; 109 (7): 074701 DOI: 10.1063/1.3560920

http://www.sciencedaily.com/releases/2011/04/110407151650.htm

Ancient Corals Provide Insight on the Future of Caribbean Reefs



This is the extinct Pliocene free-living coral Trachyphyllia bilobata collected from the northern Dominican Republic. (Credit: Neogene Marine Biota of Tropical America)

ScienceDaily (Apr. 7, 2011) — Climate change is already widely recognized to be negatively affecting coral reef ecosystems around the world, yet the long-term effects are difficult to predict. University of Miami (UM) scientists are using the geologic record of Caribbean corals to understand how reef ecosystems might respond to climate change expected for this century.

The findings are published in the current issue of the journal *Geology*.

The Pliocene epoch--more than 2.5 million years ago--can provide some insight into what coral reefs in the future may look like. Estimates of carbon dioxide and global mean temperatures of the period are similar to environmental conditions expected in the next 100 years, explains James Klaus, assistant professor in the Department of Geological Sciences, College of Arts and Sciences, at UM and lead investigator of this project. "If the coming century truly is a return to the Pliocene conditions, corals will likely survive, while well-developed reefs may not," says Klaus, who has a secondary appointment in the Rosenstiel School of Marine and Atmospheric Science (RSMAS), at UM. "This could be detrimental to the fish and marine species that rely on the reef structure for their habitat."

The study looks at the fossil records of coral communities from nine countries around the Caribbean region to better understand the nature of these ecosystems during the Pliocene. Today, fossil reefs are often found far from the sea, exposed in road cuts, quarry excavations, or river canyons due to uplift and higher ancient sea levels.

In studying the fossil reefs, the researchers uncovered a striking difference between modern and Pliocene coral communities. The Pliocene epoch was characterized by a great diversity of free-living corals. Unlike most reef corals, these corals lived unattached to the sea floor. Free-living corals were well suited to warm, nutrient-rich seas of the Pliocene. Between eight and four million years ago the origination of new free-living coral species approximately doubled that of other corals. However, free-living corals experienced abrupt extinction as seawater cooled, nutrient levels decreased, and suitable habitat was eliminated in the Caribbean. Of the 26 species of free-living corals that existed during the Pliocene, only two remain in the Caribbean

today. The modern Caribbean coral fauna is composed of those coral species that survived this extinction event.

The scientists argue that the effects of ongoing climate change are reminiscent of conditions present during the Pliocene and opposite to the environmental factors that caused the extinction and gave rise to modern Caribbean corals. So, how might the Caribbean coral fauna respond to a predicted return to Pliocene-like conditions within this century? The free-living corals of the Pliocene would have been well suited to ocean conditions projected for this century. However, the modern reef-building coral fauna may not, explains Donald McNeill, senior scientist in the Division of Marine Geology and Geophysics at UM and co-author of the study.

"Like the Pliocene, we might expect shallow reefs to be increasingly patchy with lower topographic relief," says McNeill. "Rising levels of carbon dioxide will lower the pH in the oceans, a process known as ocean acidification, and will make it difficult for corals to build their limestone skeletons."

Climate change may also increase nutrients in the oceans, boosting populations of marine life that degrade the coral into fine white sand, a process called bioerosion. Reefs built by corals in areas with high bioerosion will be affected the most. Mesophotic reefs, those growing in depths between 30 and 150 meters, have reduced rates of both calcification and bioerosion and thus may be affected less.

The study is funded by the U.S. National Science Foundation. Other authors are Dr. Scott Ishman, Professor, and Brendan Lutz, doctoral student, at Southern Illinois University; Dr. Ann Budd, Professor at the University of Iowa, and Kenneth Johnson, Researcher at the Natural History Museum, London.

Story Source:

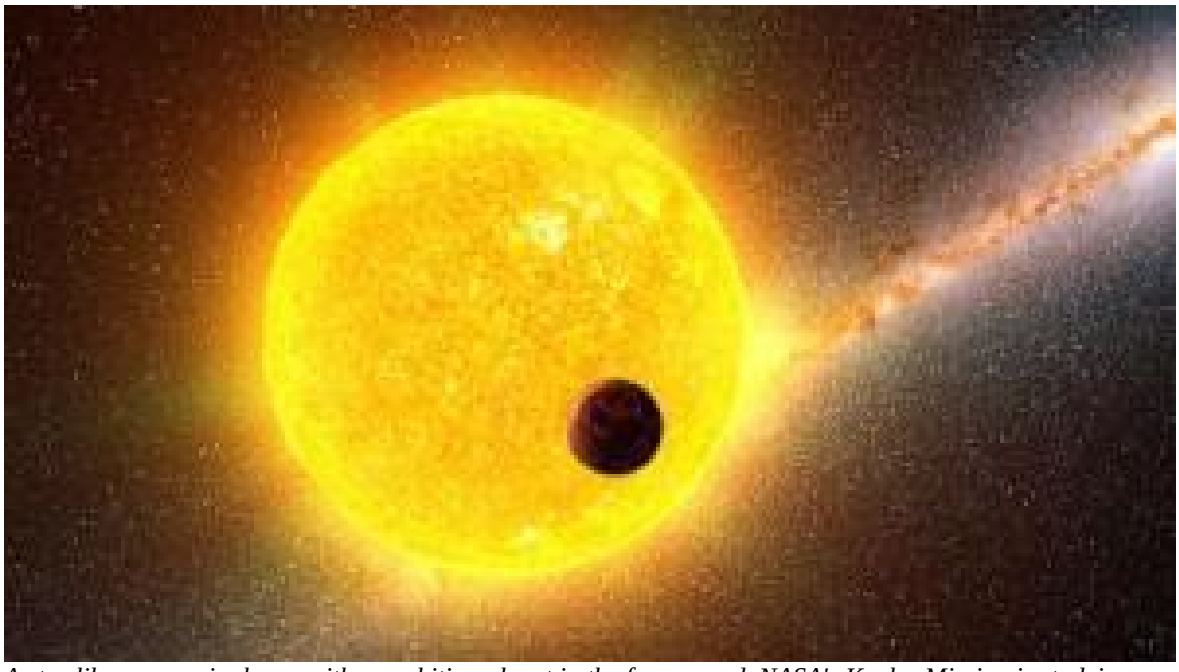
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Miami**.

Journal Reference:

1. J. S. Klaus, B. P. Lutz, D. F. McNeill, A. F. Budd, K. G. Johnson, S. E. Ishman. **Rise and fall of Pliocene free-living corals in the Caribbean**. *Geology*, 2011; 39 (4): 375 DOI: 10.1130/G31704.1

http://www.sciencedaily.com/releases/2011/04/110407141336.htm

NASA's Kepler Helps Astronomers Update Census of Sun-Like Stars



A star like our sun is shown with an orbiting planet in the foreground. NASA's Kepler Mission is studying sun-like stars by tracking changes in their brightness, or their oscillations. (Credit: Illustration by Gabriel Perez Diaz, Instituto de Aastrofisica de Canarias (MultiMedia Service).)

ScienceDaily (Apr. 7, 2011) — NASA's Kepler Mission has detected changes in brightness in 500 sun-like stars, giving astronomers a much better idea about the nature and evolution of the stars.

Prior to Kepler's launch in March 2009, astronomers had identified the changes in brightness, or oscillations, of about 25 stars similar to our sun in size, age, composition and location within the Milky Way galaxy.

The discoveries are reported in a paper, "Ensemble Asteroseismology of Solar-Type Stars with the NASA Kepler Mission," in the April 8 issue of the journal *Science*. The lead author of the paper is Bill Chaplin of the University of Birmingham in the United Kingdom.

The paper says Kepler is a big boost to asteroseismology, the study of stars by observations of their natural oscillations. Those oscillations provide clues about star basics such as mass, radius and age as well as clues about the internal structure of stars.

"This helps us understand more about the formation of stars and how they evolve," said Steve Kawaler, an Iowa State University professor of physics and astronomy, a co-author of the paper and a leader of the Kepler Asteroseismic Investigation. "These new observations allow us to measure the detailed properties of stars at an accuracy that wasn't possible before."

The Kepler spacecraft is orbiting the sun carrying a photometer, or light meter, to measure changes in star brightness. The photometer includes a telescope 37 inches in diameter connected to a 95 megapixel CCD camera. The instrument is continually pointed at the Cygnus-Lyra region of the Milky Way. It is expected to continuously observe about 170,000 stars for at least three and a half years.

Kepler's primary job is to use tiny variations in the brightness of the stars within its view to find earth-like planets that might be able to support life.

The Kepler Asteroseismic Investigation is using Kepler data to study different kinds of stars. The investigation is led by a four-member steering committee: Kawaler, Chair Ron Gilliland of the Space Telescope Science Institute based in Baltimore, Jorgen Christensen-Dalsgaard and Hans Kjeldsen, both of Aarhus University in Denmark.

Kepler has provided astronomers with so much new information, the *Science* paper says they're "entering a golden era for stellar physics."

Data from 500 sun-like stars gives astronomers a much better understanding of the stars, their properties and their evolution. It also gives astronomers data to test their theories, models and predictions about the stars and the galaxy. And it gives astronomers enough data to make meaningful statistical studies of the stars.
"But this is just the start of things," Kawaler said. "This is a first broad-brush analysis of the data we've seen. This is a preview of this new tool and the kind of detailed census that we'll be able to do."
Among the projects to come, according to the *Science* paper, are studies to determine the ages of all these sun-like stars and studies of the host stars of Earth-like planets discovered by Kepler.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Iowa State University**.

Journal Reference:

1. W. J. Chaplin et al. **Ensemble Asteroseismology of Solar-Type Stars with the NASA Kepler Mission**. *Science*, 8 April 2011: Vol. 332 no. 6026 pp. 213-216 DOI: 10.1126/science.1201827

http://www.sciencedaily.com/releases/2011/04/110407141330.htm

Starch-Controlling Gene Fuels More Protein in Soybean Plants

Ling Li and Eve Wurtele have placed a gene found only in Arabidopsis plants into soybean plants and increased the amount of protein in the soybean seeds by 30 to 60 percent. (Credit: ISU photo by Bob Elbert)

ScienceDaily (Apr. 7, 2011) — A newly discovered gene introduced into soybean plants has increased the amount of protein in the plant's seed and could hold promise for helping meet nutritional needs of a hungry world.

Eve Wurtele, professor of genetics, development and cell biology; and Ling Li, an adjunct assistant professor and an associate scientist working in her laboratory, have placed a gene found only in *Arabidopsis* plants into soybean plants and increased the amount of protein in the soybean seeds by 30 to 60 percent.

The results were a pleasant surprise to the researchers as the function of the gene, known as QQS, in the *Arabidopsis* was previously unclear because its sequence is very dissimilar from all other plant genes. *Arabidopsis* is a small, flowering plant in the mustard family that is often used in scientific research.

"Most genes contain clues in their DNA sequence as to their biological function," said Wurtele. "But this one has no sequence features that gave us any hint of what it's doing."

When the researchers neutralized the gene in *Arabidopsis*, they discovered the gene was involved in regulating starch accumulation, called deposition.

"Based on the changes in activities of other genes that occurred when we altered QQS, we conjectured that it wasn't directly involved in starch synthesis, but rather it may be involved in altering [the plant's] composition in general," said Wurtele. "We decided to test this concept by transferring the gene to an agronomically important plant species, soybean, which has a seed and is important as a source of vegetable protein and oil."

"We found that the QQS transgene increased protein production in the soybean seed," she added. "That was the best possible scenario."

In addition to having a DNA sequence that is not similar to any other gene in that or any other plant, the gene is also unusual because it has only 59 amino acids, Li said. The median size of a gene in *Arabidopsis* plants is 346 amino acids.

Li discovered the gene in 2004 and named it for her daughter.

"My daughter was a half-year old. This gene was so small and my daughter was so small," Li laughs. "QQ is my daughter's nickname in Chinese."

In addition to altering the protein-producing qualities of the gene, Wurtele hopes that the discovery may lead to greater understanding of other genes that don't have recognizable functionalities based on their sequences. "This may give us an insight into the other genes with obscure features and provide us a window as to how they function," she said.

Wurtele hopes the discovery may help people in areas who survive on protein-deficient diets.

"We were so pleased [the gene] altered composition in soybean," she said. "What if this basic research discovery could lead to increased protein content in potatoes, cassava, or other crop species that are staples to people in developing nations?

"That would be better than I imagined."

This research is supported in part by funding from the National Science Foundation and Iowa State University's Plant Science Institute.

This patent-pending technology is available for licensing from the Iowa State University Research Foundation, which also provided technology development funds.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Iowa State University**.

http://www.sciencedaily.com/releases/2011/04/110407121439.htm

Avalanche Risk: Monitoring System Warns of Slippery Slopes

Devastating landslide in Doren 2007. (Credit: Friedrich Böhringer)

ScienceDaily (Apr. 7, 2011) — As a consequence of climatic changes, the number of avalanche threats has been increasing in the Alps and other alpine regions, with fatal consequences for people and infrastructures. Continuous monitoring of every endangered area has been lacking until now due to high costs and manpower requirements. Geological researchers in Munich have now developed an inexpensive system, which with the help of several technologies can continuously monitor slopes, assess changes, and provide early warnings to communities potentially affected by landslides.

The scientists themselves hope to improve their understanding of these natural phenomena by means of long-term measurements.

Doren in the Bregenzerwald, February 2007: A slope 650 meters long breaks, resulting in a massive slide into the valley below. The nearest residential buildings are very close to the 70-meter-high rim. This barely avoided catastrophe is not the only incident. Geologists have been monitoring increasingly unstable masses of earth over the past few years in the Alps and other Alpine regions, which have slipped down slopes and on slid unchecked down valleys to more stable substrates. The scientists are primarily looking at heavy rainfall and snowmelt caused by climatie change, which in turn has caused the substrate to soften and has increased the weight on it.

Identifying potentially dangerous mountain slopes is not difficult. Many of them have been unstable for centuries, and the remains of previous slides indicate prior disasters. In addition, geological records that reveal slopes at risk are available in Alpine countries. However, it has not been possible until recently to monitor any unsettled masses continuously. In order to detect movements, experts had to insert probes into drilled pockets and measure marked points on the surface. Permanently installing such devices is, however, normally too expensive to consider. Scientists can only do their inspections at intervals using this technique and gain limited insight about the events inside the slope.

Researchers at the Technische Universität München (TUM) and the Universitaet der Bundeswehr Muenchen have now made decisive progress in the development of geo-sensors and combined them with monitoring software into an early warning system that is both flexible and inexpensive to deploy. They can also drill into the ground at several locations. "We simply fill the drill pockets with basic coaxial cable, such as one uses for antenna cables, for example," says Professor Kurosch Thuro, Engineering Geology Chair at TUM. The scientists use a very simple but effective mechanism; if the surface mass of earth starts to slip, the cable will be crushed at the transfer point against the unmoving stratum. A small transmission device on the surface records this event and forwards the information. In addition, the Engineering Geodata Department at the

Bundeswehruniversität (Prof. Otto Heunecke) distributes sensors, whose position can be determined by means of GPS, over the slope. Here also, the challenge lies in achieving precision measurements in the millimeter range using ready-made, inexpensive components for recording even the smallest movements.
As the third step, the scientists are using a new-generation measuring device, the so-called video-tachometer, which uses a laser scanner and camera. Where one once had to set up artificial reflectors to measure the direction, distance and height of a target object, today the devices recognize natural target objects, such as stones or tree stumps, for example. Scientists have now programmed the manufacturer's prototypes so that each can detect the movements of a number of target objects. The tachometer charts the structure of a cliff, for example, re-measures it at periodic intervals, and records the changes while doing so. "If we don't have to set up reflectors, we will save even more money," says Professor Thomas A. Wunderlich, Chair of Geodesy at TUM, "And we do not have any more concerns about grazing cattle running over them."
With these three components, the scientists create a granular network of monitoring points across the slope. The data is collected at a central data base. The brain of the system assesses the data together with additional parameters, which include the weather data most importantly. The researchers tested their development at Sudelfeld in the Upper Bavarian town of Oberaudorf for three and half years. A hillside there is moving and threatens several mountain pastures and a federal highway. "Impressively, the data streams have shown us what is happening to the slope, how the precipitation and frost are affecting it and what is happening from a mechanical point of view," says Kurosch Thuro. "Now, we understand these movements much better."
The scientists can evaluate individual events much better for this reason. As the slope very quickly slid four millimeters in May 2010, they knew that this distance was exceptional and a source of great concern, even though it looked minimal for that area at first. Furthermore, the assessment of the data made issuing an early warning possible even before the slope had really moved. "Because we now know how the rainfall is affecting the area, we were able to determine a threshold," explains Thuro. If the ground water pressure exceeds a certain value, the system will trigger the alarm. "Then, there is a period of two and half days between the increased level and the movement of the slope."
Affected communities get an immediate benefit from the system, because they will get the data directly and will have it translated into comprehensible charts and explanations. After an early warning has been triggered, the responsible parties can barricade the slope, re-direct traffic, or evacuate buildings, as is appropriate for the level of danger.
In collaboration with two industrial partners, the researchers are now developing the system requested by the Bundesforschungsministerium (Federal Research Ministry) and the Deutsche Forschungsgemeinschaft (German Research Foundation) for marketability, using "Early Warning System for Alpine Slopes (alpEWAS)" as the project name. Interested parties have already made themselves known and a portion of the system is already being used in Doren. Professor Thuro expects significant progress not just for the users but also for science itself. "As the number of slopes that we can monitor continues to increase, we will understand even larger relationships between individual events and the alpine macro-climate."

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Technische Universitaet Muenchen**.

http://www.sciencedaily.com/releases/2011/04/110407121437.htm

Scientists Exploit Ash Tree Pest's Chemical Communication

ARS scientists have identified a new chemical compound that the female emerald ash borer releases to communicate, which could lead to better baited traps to control this tree killing pest. (Credit: Photo by Stephen Ausmus.)

ScienceDaily (Apr. 7, 2011) — A newly identified chemical sex attractant, or pheromone, of the emerald ash borer could mean improved traps for monitoring and controlling the tree-killing beetle. That's the goal of U.S. Department of Agriculture (USDA) entomologist Allard Cossé and his colleagues.

Cossé has been searching for such attractants since 2007 as part of a multidisciplinary team of scientists from USDA's Agricultural Research Service (ARS), Forest Service (FS) and Animal and Plant Health Inspection Service (APHIS). Early success came with the identification of several attractants emitted from the bark and leaves of girdled ash trees.

That finding, in turn, led to the development of traps baited with manuka oil as a less-expensive proxy. The traps are now used to detect infestations of borers so that quarantine areas can be established to contain them.

More recently, the team discovered a macrocyclic lactone, a compound that female borers release while feeding. Large-scale field tests conducted in Canada and the United States showed that the compound attracts male borers and has potential for use in traps either alone or combined with ash-tree-based attractants, reports Cossé, at the ARS National Center for Agricultural Utilization Research in Peoria, Ill.

A key tool throughout the team's studies has been the electro-antennogram. The device records the strengths of electrical signals generated by the borer's antenna when connected to electrodes and exposed to different odors it encounters in nature.

The electro-antennogram has also proven useful in identifying attractants for three parasitic wasp species that have been approved for release as biological control agents. The team has so far developed an experimental pheromone formulation for one of the three wasp species, *Spathius agrili*, which attracts males and females alike.

Establishing natural enemies such as the wasps could help slow down the spread of the borer, creating a kind of equilibrium whereby fewer trees are lost to the beetle pest, according to Cossé.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **USDA/Agricultural Research Service**. The original article was written by Jan Suszkiw.

http://www.sciencedaily.com/releases/2011/04/110407121341.htm

iPad Helps Archaeologists

New technology is revolutionizing the precise recording of history at an ancient, lost city, bucking a tradition that has been in place for centuries. (Credit: Image courtesy of University of Cincinnati)

ScienceDaily (Apr. 7, 2011) — New technology is revolutionizing the precise recording of history at an ancient, lost city, bucking a tradition that has been in place for centuries. University of Cincinnati researchers will present "The Paperless Project: The Use of iPads in the Excavations at Pompeii"* at the 39th annual international conference of Computer Applications and Quantitative Methods in Archaeology (CAA). The conference takes place April 12-16 in Beijing, China.

UC teams of archaeologists have spent more than a decade at the site of the Roman city that was buried under a volcano in 79 AD. The project is producing a complete archaeological analysis of homes, shops and businesses at a forgotten area inside one of the busiest gates of Pompeii, the Porta Stabia.

Through years of painstaking recording of their excavations, the researchers are exploring the social and cultural scene of a lost city and how the middle class neighborhood influenced Pompeian and Roman culture. The standard archaeological approach to recording this history -- a 300-year tradition -- involves taking precise measurements, drawings and notes, all recorded on paper with pencil. But last summer, the researchers found that the handheld computers and their ability to digitally record and immediately communicate information held many advantages over a centuries-honed tradition of archaeological recording. "There's a common, archival nature to what we're doing. There's a precious timelessness, a priceless sort of quality to the data that we're gathering, so we have made an industry of being very, very careful about how we record things," explains Ellis. "Once we've excavated through it, it's gone, so ever since our undergraduate years, we've become very, very good and consistent at recording. We're excited about discovering there's another way," Ellis says.

"Because the trench supervisor is so busy, it can take days to share handwritten notes between trenches," explains Wallrodt. "Now, we can give them an (electronic) notebook every day if they want it."

Wallrodt says one of the biggest concerns of adopting the new technology was switching from drawing on a large sheet of paper to sticking one's finger on the iPad's glass. "With the iPad, there's also a lot less to carry. There's no big board for drawing, no ruler and no calculator."

The researchers say they plan to pack even more iPads on their trip to Pompeii this June. The research project is funded by the Louise Taft Semple Fund through the UC Department of Classics.

*The iPad research experiment, led by Steven Ellis, UC assistant professor of classics, and John Wallrodt, a senior research associate for the Department of Classics, has been featured on the National Geographic Channel as well as Apple's website. That's after the researchers took six iPads to UC's excavation site at Pompeii last summer. The iPads themselves were just being introduced at the time.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Cincinnati**.

http://www.sciencedaily.com/releases/2011/04/110407101625.htm

Scientists Have New Measure for Species Threat

According to the authors of the SAFE (Species Ability to Forestall Extinction) index, conservationists with limited resources may want to channel their efforts on saving the tiger, a species that is at the 'tipping point' and could have reasonable chance of survival. (Credit: Copyright Juliane Riedl)

ScienceDaily (Apr. 7, 2011) — A new index has been developed to help conservationists better understand how close species are to extinction. The index, developed by a team of Australian researchers from the University of Adelaide and James Cook University, is called SAFE (Species Ability to Forestall Extinction). The SAFE index builds on previous studies into the minimum population sizes needed by species to survive in the wild. It measures how close species are to their minimum viable population size.

"SAFE is a leap forward in how we measure relative threat risk among species," says co-author Professor Corey Bradshaw, Director of Ecological Modelling at the University of Adelaide's Environment Institute. "The idea is fairly simple -- it's the distance a population is (in terms of abundance) from its minimum viable population size. While we provide a formula for working this out, it's more than just a formula -- we've shown that SAFE is the best predictor yet of the vulnerability of mammal species to extinction."

Professor Bradshaw says SAFE is designed to be an adjunct to the International Union for Conservation of Nature (IUCN) Red List of Threatened Species, not a replacement.

"Our index shows that not all Critically Endangered species are equal. A combined approach -- using the IUCN Red List threat categories together with the SAFE index -- is more informative than the IUCN categories alone, and provides a good method for gauging the relative 'safety' of a species from extinction," he says.
Of the 95 mammal species considered in the team's analysis, more than one in five are close to extinction, and more than half of them are at 'tipping points' that could take their populations to the point of no return.
"For example, our studies show that practitioners of conservation triage may want to prioritize resources on the Sumatran rhinoceros instead of the Javan rhinoceros. Both species are Critically Endangered, but the Sumatran rhino is more likely to be brought back from the brink of extinction based on its SAFE index," Professor Bradshaw says.

"Alternatively, conservationists with limited resources may want to channel their efforts on saving the tiger, a species that is at the 'tipping point' and could have reasonable chance of survival."

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Adelaide**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Gopalasamy Reuben Clements, Corey JA Bradshaw, Barry W Brook, William F Laurance. **The SAFE index: using a threshold population target to measure relative species threat**. *Frontiers in Ecology and the Environment*, 2011; : 110330054251016 DOI: 10.1890/100177

http://www.sciencedaily.com/releases/2011/04/110407101615.htm

Genetic Differences Influence the Structure of Ecological Communities

This is a tropical tree covered with epiphyte plants. (Credit: R Preziosi)

ScienceDaily (Apr. 7, 2011) — Scientists from The University of Manchester are among a group of researchers investigating how genetic differences among individuals contribute to the way ecological communities form, interact and change over time.

They say that understanding how individuals interact and form sustainable communities can help society to address issues including food security, prevention of disease and the coexistence between humans and nature in a crowded world.

Biologists from the Universities of Manchester, York, and St Andrews have edited a special issue of *Philosophical Transactions of the Royal Society-B*, which focuses on how genetic interactions between individuals shape communities of plants and animals.

'Community Genetics: at the cross-roads of ecology and evolutionary genetics' contains 13 research articles and commentaries by researchers, from the UK, the USA and Spain, examining how variation within species changes interactions among species.

The issue's co-editor, Dr Richard Preziosi, of the Faculty of Life Sciences in Manchester, said: "This research featured in this special issue of the journal reveals how genetic differences within species affect the wildlife communities of the whole local ecosystem."

Dr Preziosi's own research, which features in the special-issue journal, examined how the underlying genetic make-up of an individual tree can affect the community of associated species in a diverse and complex tropical rainforest ecosystem.

The Manchester team studied the plant and invertebrate communities that live on the Breadnut trees of the tropical forests of Belize in Central America to discover the extent to which an individual tree determines what species live on and around it.

"We found that more genetically similar trees were host to more similar communities of epiphytic plants, leaf litter invertebrates and trunk invertebrates," said Dr Preziosi. "The discovery was surprising given the diversity of the rainforest system and the numerous interactions between species that occur within it.

"Our work shows that there may be structuring within these ecosystems at the level of the trees, which has high biological significance in terms of rainforest conservation and restoration."

The team used ropes and harnesses to climb high into the forest canopy and count each orchid and bromeliad plant growing on 53 different Breadnut trees (*Brosimum alicastrum*). They also used pitfall traps, leaf litter collections and trunk traps to survey the invertebrates on each tree.

"In total, more than 2,100 individual plants were counted from 46 orchid and 17 bromeliad species, and 1,900 invertebrates from more than 80 species were also recorded," said Dr Sharon Zytynska, who carried out much of the work.

"The trees were all genotyped to tell us how genetically similar each one was to another and then the associated communities of each tree compared. The findings we observed suggest that a population of genetically similar trees would host a reduced diversity of plants and animals.

"This would have a knock-on effect for higher organisms too, such as the pollinators associated with the orchids or the amphibians that feed on the invertebrates, so have important implications for conservation efforts in these forests."

Story Source:

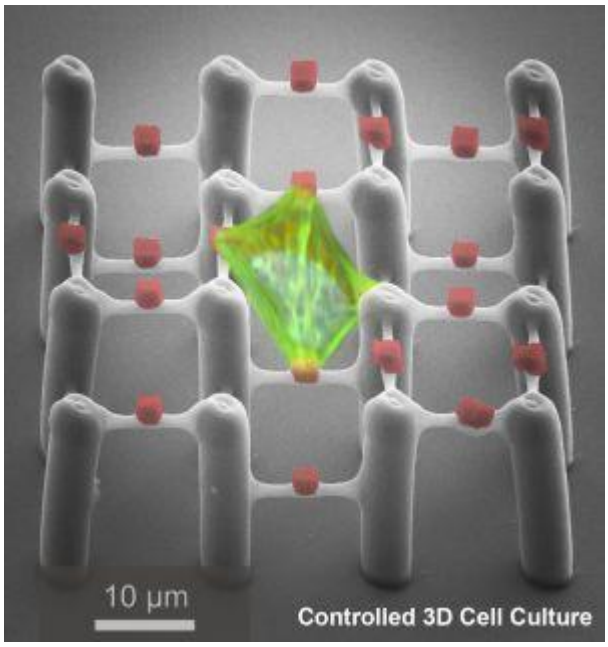
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Manchester**.

Journal Reference:

1. J. K. Rowntree, D. M. Shuker, R. F. Preziosi. **Forward from the crossroads of ecology and evolution**. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 2011; 366 (1569): 1322 DOI: 10.1098/rstb.2010.0357

http://www.sciencedaily.com/releases/2011/04/110407093238.htm

Third Dimension of Specific Cell Cultivation



Cell in the two-component polymer scaffold. The photo composition is based on a scanning electron microscopy and laser scanning microscopy. (Credit: CFN)

ScienceDaily (Apr. 6, 2011) — At Karlsruhe Institute of Technology (KIT), researchers of the DFG Center for Functional Nanostructures (CFN) succeeded in specifically cultivating cells on three-dimensional structures. The fascinating thing is that the cells are offered small "holds" in the micrometer range on the scaffold, to which they can adhere. Adhesion is possible to these holds only, not to the remaining structure. For the first time, cell adhesion and, hence, cell shape are influenced precisely in three dimensions. The team headed by Professor Martin Bastmeyer thus has achieved big progress in the field of biomaterial engineering.

So far, several approaches have been used to cell culture in three-dimensional environments which are mostly produced from agarose, collagen fibers or matrigel. They are to simulate the flexible three-dimensional reality in which the cells act normally and, hence, allow for more realistic experiments than those using cell cultures in "two-dimensional Petri dishes." All approaches used so far have one common feature: They are mostly heterogeneous with random pore sizes. They have hardly been characterized structurally and biochemically.

It was the objective of the group under the direction of Bastmeyer to develop defined three-dimensional growth substrates for the cell culture. The cells are to adhere at certain points only rather than randomly. In this way, parameters, such as the cell shape, cell volume, intercellular force development, or cellular differentiation can be determined systematically as a function of the external geometry of the surroundings. These findings are needed for the later specific larger-scale production of three-dimensional growth environments for tissue cultures required in regenerative medicine, for instance.

This objective was reached by means of a special polymer scaffold. The scaffold consists of a flexible, protein-repellent polymer with small box-shaped holds made of a protein-binding material. For scaffold construction, the scientists used the Direct Laser Writing Method (DLS) developed by the physicists Professor Martin Wegener and Professor Georg von Freymann at CFN. By means of this process, the protein-repellent structure was fabricated. It consists of 25 µm high pillars that are connected by thin bars at various heights. In a second lithography step, the holds were placed exactly in the middle of the bars. With the help of a solution of adhesion proteins, the proteins only bind to these small holds. Within two hours, individual cells colonize the scaffolds and adhere to the given adhesion points only.

For the first time, the scientists of CFN, Karlsruhe, succeeded in producing suitable materials, in which the growth of individual cells can be controlled and manipulated specifically in three dimensions. This is an important step towards the general understanding of how the natural three-dimensional environment in the tissue influences the behavior of cells.

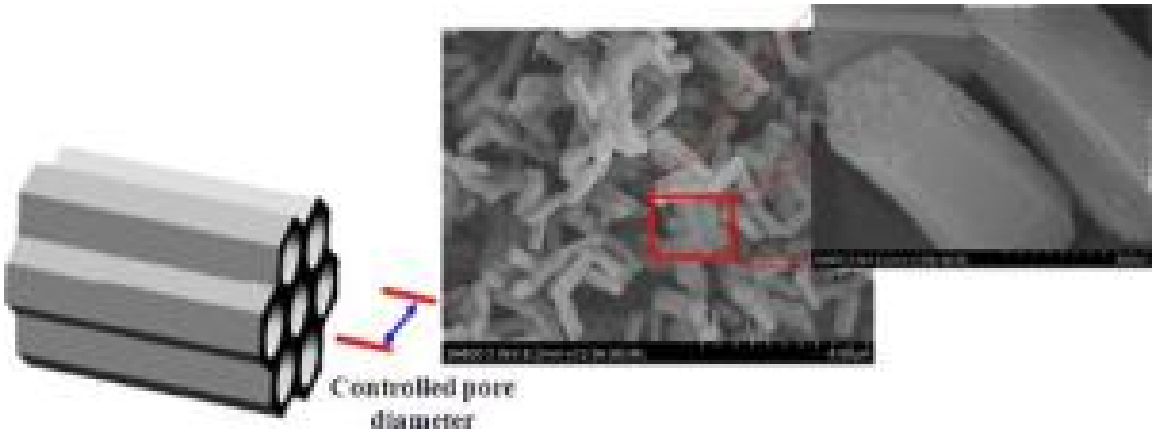
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Helmholtz Association of German Research Centres**.

Journal Reference:

1. Franziska Klein, Benjamin Richter, Thomas Striebel, Clemens M. Franz, Georg von Freymann, Martin Wegener, Martin Bastmeyer. **Two-Component Polymer Scaffolds for Controlled Three-Dimensional Cell Culture**. *Advanced Materials*, 2011; 23 (11): 1341 DOI: 10.1002/adma.201004060

http://www.sciencedaily.com/releases/2011/04/110406102133.htm

Nano Fitness: Helping Enzymes Stay Active and Keep in Shape



Rensselaer researchers confined lysozyme and other enzymes inside carefully engineered nanoscale holes. Instead of denaturing, these embedded enzymes mostly retained their 3-D structure and exhibited a significant increase in activity. (Credit: Image courtesy of Rensselaer Polytechnic Institute)

ScienceDaily (Apr. 6, 2011) — Proteins are critically important to life and the human body. They are also among the most complex molecules in nature, and there is much we still don't know or understand about them.

One key challenge is the stability of enzymes, a particular type of protein that speeds up, or catalyzes, chemical reactions. Taken out of their natural environment in the cell or body, enzymes can quickly lose their shape and denature. Everyday examples of enzymes denaturing include milk going sour, or eggs turning solid when boiled.

Rensselaer Polytechnic Institute Professor Marc-Olivier Coppens has developed a new technique for boosting the stability of enzymes, making them useful under a much broader range of conditions. Coppens confined lysozyme and other enzymes inside carefully engineered nanoscale holes, or nanopores. Instead of denaturing, these embedded enzymes mostly retained their 3-D structure and exhibited a significant increase in activity.

"Normally, when you put an enzyme on a surface, its activity goes down. But in this study, we discovered that when we put enzymes in nanopores -- a highly controlled environment -- the enzymatic activity goes up dramatically," said Coppens, a professor in the Department of Chemical and Biological Engineering at Rensselaer. "The enzymatic activity turns out to be very dependent on the local environment. This is very exciting."

Results of the study were published last month by the journal *Physical Chemistry Chemical Physics*.

Researchers at Rensselaer and elsewhere have made important discoveries by wrapping enzymes and other proteins around nanomaterials. While this immobilizes the enzyme and often results in high stability and novel properties, the enzyme's activity decreases as it loses its natural 3-D structure.

Coppens took a different approach, and inserted enzymes inside nanopores. Measuring only 3-4 nanometers (nm) in size, the enzyme lysozyme fits snugly into a nanoporous material with well-controlled pore size between 5 nm and 12 nm. Confined to this compact space, the enzymes have a much harder time unfolding or wiggling around, Coppens said.

The discovery raises many questions and opens up entirely new possibilities related to biology, chemistry, medicine, and nanoengineering, Coppens said. He envisions this technology could be adapted to better control nanoscale environments, as well as increase the activity and selectivity of different enzymes. Looking forward, Coppens and colleagues will employ molecular simulations, multiscale modeling methods, and physical experiments to better understand the fundamental mechanics of confining enzymes inside nanopores.

The study was co-authored by Lung-Ching Sang, a former Rensselaer graduate student in the Department of Chemical and Biological Engineering.

This research was supported by the National Science Foundation, via the Nanoscale Science and Engineering Center for Directed Assembly of Nanostructures at Rensselaer. The project was also supported by the International Center for Materials Nanoarchitectonics of the National Institute for Materials Science, Japan.

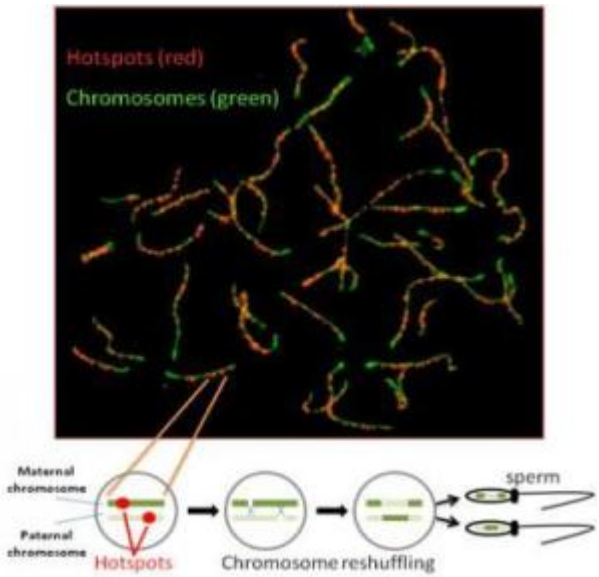
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Rensselaer Polytechnic Institute**.

Journal Reference:

1. Lung-Ching Sang, Marc-Olivier Coppens. **Effects of surface curvature and surface chemistry on the structure and activity of proteins adsorbed in nanopores**. *Physical Chemistry Chemical Physics*, 2011; 13 (14): 6689 DOI: 10.1039/C0CP02273J

http://www.sciencedaily.com/releases/2011/04/110406131847.htm

Hotspots of Genetic Rearrangement: Findings in Mice Could Aid Understanding of How Mammals Genetically Adapt



In this image, hundredfold magnification of a single sperm precursor cell shows the chromosomes -- in green -- and the places where these chromosomes are most likely to break apart and re-form, called genetic recombination hotspots -- in red. Genetic rearrangements at these hotspots have the potential to shuffle maternal and paternal chromosomes, the end results of which ensure that the genetic information in every sperm cell is unique. (Credit: Fatima Smagulova, Ph.D., USU, and Kevin Brick, Ph.D., NIDDK, NIH)

ScienceDaily (Apr. 6, 2011) — Researchers have zoomed in on mouse chromosomes to map hotspots of genetic recombination -- sites where DNA breaks and reforms to shuffle genes. The findings of the scientists at the National Institutes of Health and Uniformed Services University of Health Sciences (USU) have the potential to improve the detection of genes linked to disease and to help understand the root causes of genetic abnormalities.

The research, published online April 3 in *Nature*, moves scientists one step closer to understanding how mammals evolve and respond to their environments.

In this image, hundredfold magnification of a single sperm precursor cell shows the chromosomes -- in green -- and the places where these chromosomes are most likely to break apart and re-form, called genetic recombination hotspots -- in red. Genetic rearrangements at these hotspots have the potential to shuffle maternal and paternal chromosomes, the end results of which ensure that the genetic information in every sperm cell is unique. Source: Fatima Smagulova, Ph.D., USU, and Kevin Brick, Ph.D., NIDDK, NIH.Genetic recombination occurs at hotspots in cells that form sperm and eggs. At these sites, rearrangements ensure that the combination of genes passed on to every sperm and egg cell is unique. By studying precursors of mouse sperm cells during the early stages of genetic recombination, the scientists have created a precise, first-of-its-kind map of recombination hotspots in a multi-celled organism.

With this map, researchers also hope to pinpoint where, how and why abnormalities in the number of chromosomes can occur. Such abnormalities -- for instance, the extra copy of chromosome 21 that gives rise to Down syndrome -- are the leading known cause of miscarriages, congenital birth defects, and mental retardation in the United States.

"We wanted to figure out how recombination varied across the genome," said R. Daniel Camerini-Otero, M.D., Ph.D., one of the senior authors on the paper and a researcher at the NIH's National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK). "Hotspots are the starting point for the process that ensures that every person is unique. These hotspots facilitate the adaptation of populations to environmental influences through evolution. Our findings will allow us to explore things like how environment and genetic background affect the recombination landscape."

"Now that we have mapped recombination hotspots genome-wide, we can actually carry out studies on the whole mouse genome. This will be very beneficial in extending our knowledge to organisms as complex as humans," said Galina Petukhova, Ph.D., assistant professor in the USU Department of Biology and one of the paper's senior authors. "Faulty recombination can lead to infertility or birth defects, and this work brings us closer to our ultimate goal of helping to prevent these health issues."

Camerini-Otero compared the map's new level of precision to the difference between being able to zoom in to see a city block to being able to zoom in to see each building on the block. "What we were looking for was resolution that was much higher than ever seen before," said Camerini-Otero. "Now that we can actually see these individual events of genetic recombination, we can begin to understand their molecular structure."

The researchers -- including lead authors Fatima Smagulova, Ph.D., of USU, and Ivan V. Gregoretti, Ph.D., of NIDDK -- used cutting-edge DNA sequencing technology and lots of computational power to take a snapshot of all the individual pieces of DNA that were taking part in recombination at a given moment in living cells. They then used this snapshot of short DNA pieces to draw a map of where chromosomes have an increased potential to be broken and to come back together in new ways.

Mice were used as subjects for this study because the researchers needed a population that could be created with a specific and identical genetic background. With this initial study a success, they hope to apply the same techniques to study recombination in people in the near future.

The end result is a catalog of about 10,000 hotspots and resembles a detailed map of where diversity can arise in the genome and of sites where such processes may go awry. The researchers next plan to apply what they've seen and learned with this new map to further understand chromosomal abnormalities, genetic recombination, genome stability and evolution.

The NIH's National Institute of General Medical Sciences and the March of Dimes Foundation helped fund this research through grants to Petukhova.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **NIH/National Institute of Diabetes and Digestive and Kidney Diseases**.

Journal Reference:

1. Fatima Smagulova, Ivan V. Gregoretti, Kevin Brick, Pavel Khil, R. Daniel Camerini-Otero, Galina V. Petukhova. **Genome-wide analysis reveals novel molecular features of mouse recombination hotspots**. *Nature*, 2011; DOI: 10.1038/nature09869

http://www.sciencedaily.com/releases/2011/04/110405175014.htm

Healthy Welders May Be at Increased Risk for Early Brain Damage

Welding fumes may increase risk of damage to the same brain area harmed by Parkinson's disease, researchers at Washington University School of Medicine in St. Louis have found. (Credit: Michael C. Purdy)

ScienceDaily (Apr. 6, 2011) — New research suggests that workers exposed to welding fumes may be at risk for developing brain damage in an area of the brain also affected in Parkinson's disease. The study is published in the April 6, 2011, online issue of *Neurology*®, the medical journal of the American Academy of Neurology.

Fumes produced by welding contain manganese. Manganese is a chemical element that, even at low levels, has been linked to neurologic problems, including Parkinson's disease-like symptoms.

"There are over one million workers who perform welding as part of their job functions in the United States," said Brad A. Racette, MD, with Washington University School of Medicine in St. Louis and a Fellow with the American Academy of Neurology. "If a link between neurotoxic effects and these fumes were proven, it would have a substantial public health impact for the U.S. workforce and economy."

The study involved 20 welders with no symptoms of Parkinson's disease, 20 people with Parkinson's disease who were not welders and 20 people who were not welders and did not have Parkinson's. The welders were recruited from two Midwest shipyards and one metal fabrication company. All participants were given brain PET and MRI scans, motor skills tests and examined by a neurologist who specializes in movement disorders. The welders had an average of 30,000 hours of lifetime welding exposure. Their average manganese levels were found to be two times the upper limits of normal.

Scientists found that welders had an average 11.7 percent reduction in a marker of dopamine in one area of the brain on PET scans as compared to people who did not weld. Dopamine is a chemical messenger that helps nerve cells communicate and is decreased in specific brain regions in people with Parkinson's disease. The welders' motor skills test scores also showed mild movement difficulties that were about half of that found in the early Parkinson's disease patients.

"While these changes in the brain and dopamine dysfunction may be an early marker of neuron death related to welding exposure, the damage appeared to be different from those of people with full-fledged Parkinson's disease," said Racette. "MRI scans also revealed brain changes in welders that were consistent with manganese deposits in the brain."

"Although this study shows that these workers had dopamine dysfunction in the brain, the study authors could not determine whether this was specifically related to manganese," said W. R. Wayne Martin, MD, who wrote an accompanying editorial on the topic. Martin is with the University of Alberta in Edmonton, Alberta, Canada and a member of the American Academy of Neurology. "Will these individuals develop full-fledged Parkinson's disease? We can't answer that question based on the study but more research should be done to explore this possibility."

The study was supported by the Michael J. Fox Foundation, the National Institutes of Health, the American Parkinson Disease Association, Advanced Research Center at Washington University, the Great St. Louis Chapter of the ADPA, the McDonnell Center for Higher Brain Function and the Barnes-Jewish Hospital Foundation.

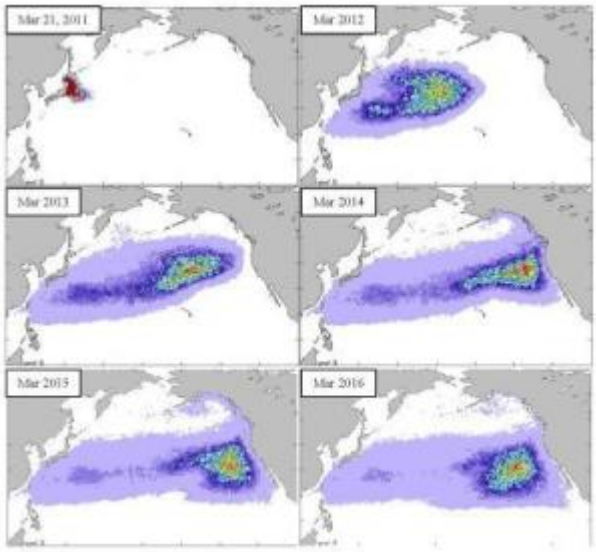
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **American Academy of Neurology**.

Journal Reference:

1. Criswell SR, Perlmutter JS, Videen TO, Moerlein SM, Flores HP, Birke AM, Racette BA. **Reduced uptake of [18F]FDOPA PET in asymptomatic welders with occupational manganese exposure**. *Neurology*, April 6, 2011

http://www.sciencedaily.com/releases/2011/04/110406161028.htm

Where Will the Debris from Japan's Tsunami Drift in the Ocean?



This figure shows the probable pathways of the debris that entered the ocean on March 11, 2011, as estimated from historical trajectories of drifting buoys. (Credit: Nikolai Maximenko, International Pacific Research Center)

ScienceDaily (Apr. 6, 2011) — The huge tsunami triggered by the 9.0 Tohoku Earthquake destroyed coastal towns near Sendai in Japan, washing such things as houses and cars into the ocean.

Projections of where this debris might head have been made by Nikolai Maximenko and Jan Hafner at the International Pacific Research Center, University of Hawaii at Manoa. Maximenko has developed a model based on the behavior of drifting buoys deployed over years in the ocean for scientific purposes.

The debris first spreads out eastward from the Japan Coast in the North Pacific Subtropical Gyre. In a year, the Northwestern Hawaiian Islands Marine National Monument will see pieces washing up on its shores; in two years, the remaining Hawaiian islands will see some effects; in three years, the plume will reach the US West Coast, dumping debris on Californian beaches and the beaches of British Columbia, Alaska, and Baja California. The debris will then drift into the famous North Pacific Garbage Patch, where it will wander around and break into smaller and smaller pieces. In five years, Hawaii shores can expect to see another barrage of debris that is stronger and longer-lasting than the first one. Much of the debris leaving the North Pacific Garbage Patch ends up on Hawaii's reefs and beaches.

These model projections will help to guide clean-up and tracking operations. Tracking will be important in determining what happens to different materials in the tsunami debris, for example, how the composition of the debris plume changes with time, and how the winds and currents separate objects drifting at different speeds.

Even before the tsunami, the World Ocean was a dump for rubbish flowing in from rivers, washed off beaches, and jettisoned from oil and gas platforms and from fishing, tourist, and merchant vessels. Marine debris has become a serious problem for marine ecosystems, fisheries, and shipping. The presentations given at the recent week-long 5th International Marine Debris Conference in Hawaii, at which Maximenko had organized a day-long workshop, are a testimony to the magnitude of the ocean debris problem. The massive, concentrated debris launched by the devastating tsunami is now magnifying the hazards.

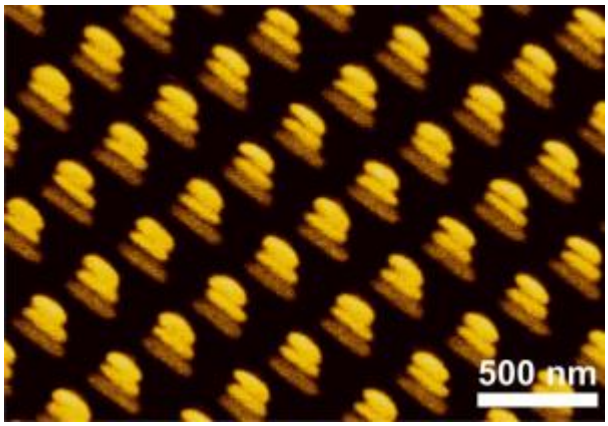
Maximenko's long-standing work on ocean currents and transports predicted that there are five major regions in the World Ocean where debris collects if it is not washed up on shores or sinks to the ocean bottom, deteriorates, or is ingested by marine organisms. These regions turn out to be "garbage patches." The North Pacific Garbage Patch has become famous, the North Atlantic Patch was fixed some years ago, and the South Atlantic, South Indian Ocean, and South Pacific patches have just been found, guided by the map of his model that shows where floating marine debris should collect.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Hawaii at Manoa**, via EurekAlert!, a service of AAAS.

http://www.sciencedaily.com/releases/2011/04/110406102203.htm

Improving High-Speed Optical Data Transfer by Employing Ideas from TV Antennas



Tilted scanning electron micrograph of the optical Yagi-Uda nanoantenna-array. (Credit: Image courtesy of University of Stuttgart)

ScienceDaily (Apr. 6, 2011) — Standard TV antennas receive signals carried by electromagnetic waves with frequencies in the MHz range and convert them into pulses of electric currents in the connected cables. The antenna connects two very different length scales: the carrier wavelength, ranging from centimeters to meters, and the size of the wiring, typically on the millimeter scale.

Now, physicists at the 4th Physics Institute of the University of Stuttgart in collaboration with researchers at the Max-Planck-Institute for Solid State Research, have successfully applied this radiofrequency antenna concept to the optical wavelength range. They realized metallic structures of only 100 nanometers in size, which efficiently receive optical frequencies in the range of several hundreds of THz. This opens up new possibilities to speed up optical data transfer. The results have been reported on Apr. 5, 2011, in the scientific journal *Nature Communications.*

Certain antenna geometries are known to receive radiation from designated directions. Such a unidirectional TV antenna is the so-called Yagi-Uda-antenna, invented by Yagi and Uda in 1926. Consisting of several aligned parallel dipole antennas of different lengths, the Yagi-Uda antenna can be tuned to receive signals from a given direction 5 to 10 times more efficiently than a dipole antenna. The received signal can be even more enhanced by several orders of magnitude when the single antenna is expanded to an array of Yagi-Uda antennas. Such antenna arrays are used to transmit signals over very large distances, for example in satellite communication.

The researchers who teamed up their efforts in the local research center SCoPE (Stuttgart Center of Photonics Engineering) have been inspired by this highly efficient signal transmission in telecommunication engineering and scaled down the concept of Yagi-Uda antenna arrays to optical wavelengths. PhD student Daniel Dregely fabricated three-dimensional gold wire arrays of different lengths and stacked them one above another with nanometer precision. To achieve this, he used state-of-the-art nanotechnology and processed layer by layer with dielectric spacers in between. A periodic arrangement of the single Yagi-Uda nanoantennas then formed the investigated optical antenna arrays.

Measurements on the three dimensional arrays revealed that the amount of absorbed energy strongly depends on the angle of incidence and on the frequency of the incident electromagnetic waves. The scientists showed in particular that maximal absorption of incident radiation occurs at 200 THz, only if light impinges from the direction parallel to the antenna axis of the individual Yagi-Uda antenna. For this particular situation the incoming wave of 1500 nm length is confined to a subwavelength region extending to only about 100 nm. This can be used in future for very sensitive detection of near-infrared radiation on the nanoscale. One of the big advantages of their optical antenna arrays is the fact that its three-dimensional character couples to radiation normal to the surface. This is in particular advantageous for light emitters, such as LEDs, or very sensitive photodetectors.

Furthermore, the researchers showed in numerical calculations that the combination of three-dimensional optical Yagi-Uda nanoantenna arrays with suitable feed circuits gives rise to the prospect of beam steering at optical wavelengths. Controlling the phase of the individual nanoantennas in the array leads to complete control over the emission cone direction. The scientists believe that the experimental realization of a "phased array" at optical wavelengths opens the pathway to new avenues in optical high speed data transfer on the micrometer scale, for example on microchips in high-performance computer circuits.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Stuttgart**, via AlphaGalileo.

Journal Reference:

1. Daniel Dregely, Richard Taubert, Jens Dorfmüller, Ralf Vogelgesang, Klaus Kern, Harald Giessen. **3D optical Yagi–Uda nanoantenna array**. *Nature Communications*, 2011; 2: 271 DOI: 10.1038/ncomms1268

http://www.sciencedaily.com/releases/2011/04/110406085638.htm

Active Electromagnetic Suspension System Can Increase Ride Quality of Cars by 60 Percent

Eindhoven University researcher Bart Gysen and the test car fitted with the new suspension system. (Credit: Image courtesy of Eindhoven University of Technology)

ScienceDaily (Apr. 6, 2011) — Researchers at Eindhoven University of Technology (TU/e, Netherlands) have developed an active electromagnetic suspension system that can increase the ride quality of cars by 60 percent. Cars fitted with this suspension system are also safer because they no longer roll (sway) in corners. The system was developed at TU/e in partnership with the Swedish company SKF, and was recently installed in a BMW test car to be shown at the AutoRAI exhibition, Amsterdam, from 13-23 April 2011.

A demonstration of the new suspension system starts with a striking scene: a standard-looking, dark blue BMW 530i that hops up and down like a 'lowrider' in hip-hop video clips. "Of course that isn't the intention," explains ir. Bart Gysen, who is working for his PhD on the development of the system. "But it certainly shows what the system can do." The car's wheels can be raised and lowered independently in a fraction of a second. And this high speed is one of the most special features of the system. There are already active suspension systems, but these are hydraulic, which means their response is not fast enough to cancel out the rapid vibrations caused by irregularities in the road surface. The new system can do this effectively, which explains the better ride quality.

Vibration-free ambulances

The system developed by Gysen was tested last year on a testbed that simulates road-surface vibrations on just one wheel. That resulted in an increase of 60 percent in ride quality. "We expect that this increased comfort can also be achieved with a real car," Gysen explains. "And possibly even more, when all four wheels are fitted with the system." The aim is ultimately to develop more comfortable cars that also have higher safety. This is because the roadholding is improved and the car no longer rolls in bends. For example a car fitted with this suspension system will be much less likely to overturn as a result of abrupt steering maneuvers, such as the slaloming involved in the notorious 'elk test'. Gysen also believes the system will be attractive for use in ambulances. "An ambulance fitted with this system will be able to transport patients quickly and free of disturbing road-surface vibrations."

Inherently safe

The system replaces the normal shock absorber in a car, and itself has approximately the same size as a shock absorber. It consists of a passive spring, a powerful electromagnetic actuator, a control unit and batteries. The system is designed to be inherently safe. Even if the electrical power fails, the springing and shock absorbers will continue to work. The passive spring in the system provides springing, and the magnets provide passive, magnetic shock absorption.

Generating power

According to Gysen the system's energy consumption is modest. "If you install this suspension system on all four wheels, the peak consumption is 500 watt -- half of what an air-conditioning system uses. Hydraulic suspension systems use four times as much power. And the consumption of our system can probably be reduced still further by optimization. This is only the first version." As well as that the system can even use the vibrations from the road surface to generate electricity, which is fed back into the battery.

Coordination

Last month the suspension system was installed on two wheels of a test car for practical tests and further development. One of the tasks is to coordinate the behavior of the active suspension on the individual wheels. At present the separate wheel systems still work independently. SKF, which has financed Gysen's doctoral research and has also patented the technology, is currently considering whether to market the new suspension system.

AutoRAI

The test car fitted with the new suspension system will be on show at the AutoRAI auto show, to be held from 13 to 23 April in Amsterdam, on the HTAS Automotive Innovation stand number E.01 (Elicium, Auto 2.0). The stand will be manned by personnel who can demonstrate the car and the new suspension system.

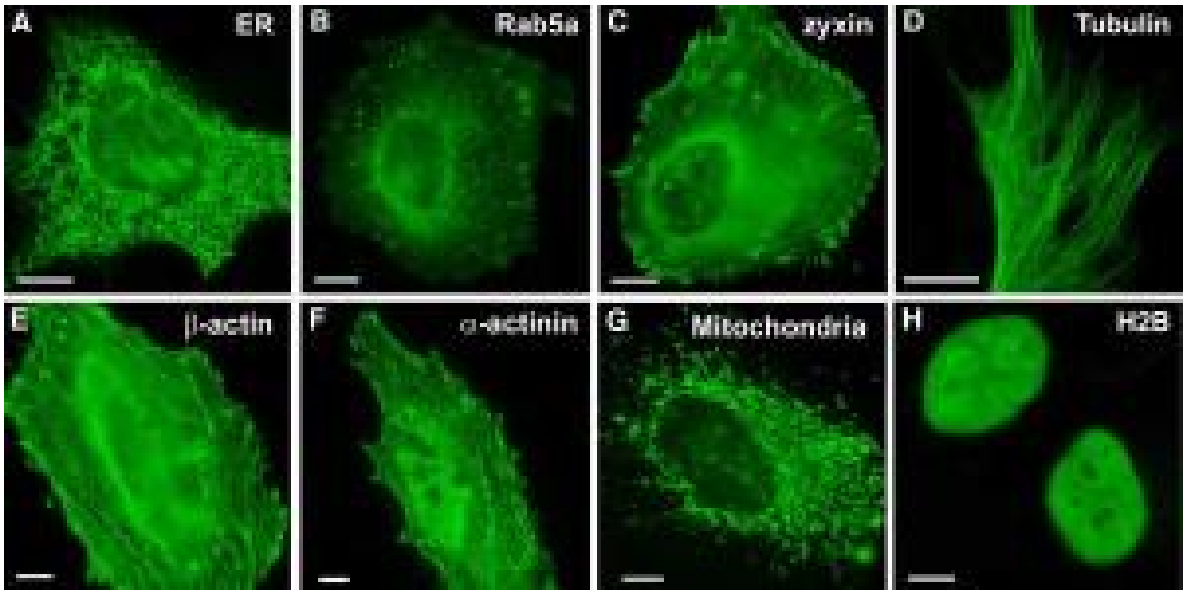
Ir. Bart Gysen developed the electromagnetic spring-damper system in the TU/e Electromechanics and Power Electronics group (Department of Electrical Engineering), led by prof.dr. Elena Lomonova. Gysen expects to gain his PhD at Eindhoven University of Technology in 2011.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Eindhoven University of Technology**, via AlphaGalileo.

http://www.sciencedaily.com/releases/2011/04/110405102042.htm

Electron Microscopy: New Type of Genetic Tag Illuminates Life in Never-Before-Seen Detail



Confocal fluorescence images of miniSOG-targeted endoplasmic reticulum (A), Rab5a (B), zyxin (C), tubulin (D), ²-actin (E), ±-actinin (F), mitochondria (G), and histone 2B (H) in HeLa cells; scale bars, 10 µm. (Credit: Xiaokun Shu, Varda Lev-Ram, Thomas J. Deerinck, Yingchuan Qi, Ericka B. Ramko, Michael W. Davidson, Yishi Jin, Mark H. Ellisman, Roger Y. Tsien. A Genetically Encoded Tag for Correlated Light and Electron Microscopy of Intact Cells, Tissues, and Organisms. PLoS Biology, 2011; 9 (4): e1001041 DOI: 10.1371/journal.pbio.1001041)

ScienceDaily (Apr. 6, 2011) — By modifying a protein from a plant that is much favored by science, researchers at the University of California, San Diego School of Medicine and colleagues have created a new type of genetic tag visible under an electron microscope, illuminating life in never-before-seen detail.

Led by Nobel laureate Roger Tsien, PhD, Howard Hughes Medical Institute investigator and UCSD professor of pharmacology, chemistry and biochemistry, a team of scientists radically re-engineered a light-absorbing protein from the flowering cress plant *Arabidopsis thaliana*. When exposed to blue light, the altered protein produces abundant singlet oxygen, a form of molecular oxygen that can be made visible by electron microscopy (EM).

The findings are published in the online, open access journal *PLoS Biology*.

Tsien was co-winner of the 2008 Nobel Prize in chemistry for his role in helping develop and expand the use of green fluorescent protein (GFP), a protein from jellyfish that is now widely employed in light microscopy to peer inside living cells or whole animals and observe molecules interacting in real-time. Tsien said the development of the small, highly engineered *Arabidopsis* protein, dubbed "miniSOG," may elevate the abilities of electron microscopy in the same way that GFP and its relatives have made modern light microscopy in biological research much more powerful and useful.

"The big advantage of EM is that it has much higher spatial resolution than light microscopy. You can get up to a hundred-fold higher useful magnification from EM than from light microscopy," said Tsien. The result has been extraordinarily detailed, three-dimensional images of microscopic objects at resolutions measuring in the tens of nanometers, tiny enough to meticulously render the internal anatomy of individual cells. But current EM technologies do not distinguish or highlight individual proteins in these images. Although individual proteins can be tagged with GFP or other fluorescent proteins to aid localization by light microscopy, there has been no equivalent technology for the higher-resolution images provided by EM.

To create this ability, the scientists began with a protein from Arabidopsis that absorbs incoming blue light. It's normal function is to trigger biochemical signals that inform the plant how much sunlight it is receiving. "We rationally engineered the protein based on its atomic model so that it changes incoming blue light into a little bit of green fluorescence and a lot of singlet oxygen," said the paper's first author, Xiaokun Shu, now an

assistant professor at UC San Francisco. Established methods were then used to convert singlet oxygen production into a tissue stain that the electron microscope can "see." The scientists tested the modified protein's utility as an EM marker by first using it to confirm the locations of several well-understood proteins in mammalian cells, nematodes and rodents, and then used miniSOG to successfully tag two neuronal proteins in mice whose locations had not been known.

Tsien is optimistic that miniSOG will grant new powers to electron microscopy, permitting scientists to pursue answers to questions previously impossible to ask. MiniSOG will especially be useful to scientists who investigate cellular and subcellular structures including neuronal circuits at nanometer resolution in multicellular organisms since previous methods have great difficulty in achieving both efficient labeling and good preservation of the structures under study. While EM can provide much higher useful magnification than light microscopy, EM will not replace light microscopy. "When we use miniSOG, we see the tagged proteins plus the landmarks that we are used to navigating by," said Tsien. "On the other hand, EM has the disadvantage that it gives a snapshot of cells before we killed them (to make the image), whereas light microscopy can show the dynamics in live cells. Each technique has different complementary strengths and weaknesses."

Co-authors of the paper include: Varda Lev-Ram, UCSD Department of Pharmacology; Thomas J. Deerinck, National Center for Microscopy and Imaging Research, Center for Research on Biological Systems, UCSD; Yingchuan Qi and Yishi Jin, Howard Hughes Medical Institute, UCSD and UCSD Division of Biological Science; Ericka B. Ramko and Michael W. Davidson, National High Magnetic Field Laboratory and Department of Biological Science, Florida State University; and Mark H. Ellisman, National Center for Microscopy and Imaging Research, Center for Research on Biological Systems, UCSD and UCSD Department of Neurosciences

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Public Library of Science**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Xiaokun Shu, Varda Lev-Ram, Thomas J. Deerinck, Yingchuan Qi, Ericka B. Ramko, Michael W. Davidson, Yishi Jin, Mark H. Ellisman, Roger Y. Tsien. **A Genetically Encoded Tag for Correlated Light and Electron Microscopy of Intact Cells, Tissues, and Organisms**. *PLoS Biology*, 2011; 9 (4): e1001041 DOI: 10.1371/journal.pbio.1001041

http://www.sciencedaily.com/releases/2011/04/110405174849.htm

Scientists Develop New Technology for Stroke Rehabilitation

The new technologies will help patient rehabilitation. (Credit: University of Southampton)

ScienceDaily (Apr. 6, 2011) — Devices which could be used to rehabilitate the arms and hands of people who have experienced a stroke have been developed by researchers at the University of Southampton.

In a paper to be presented this week (6 April) at the Institution of Engineering and Technology (IET) Assisted Living Conference, Dr Geoff Merrett, a lecturer in electronic systems and devices, will describe the design and evaluation of three technologies which could help people who are affected by stroke to regain movement in their hand and arm.

Dr Merrett worked with Dr Sara Demain, a lecturer in physiotherapy and Dr Cheryl Metcalf, a researcher in electronic systems and devices, to develop three 'tactile' devices which generate a realistic 'sense of touch' and sensation -- mimicking those involved in everyday activities.

Dr Demain says: "Most stroke rehabilitation systems ignore the role of sensation and they only allow people repetitive movement. Our aim is to develop technology which provides people with a sense of holding something or of feeling something, like, for example, holding a hot cup of tea, and we want to integrate this with improving motor function."

Three tactile devices were developed and tested on patients who had had a stroke and on healthy participants. The devices were: a 'vibration' tactile device, which users felt provided a good indication of touch but did not really feel as if they were holding anything; a 'motor-driven squeezer' device, which users said felt like they were holding something, a bit like catching a ball; and a 'shape memory alloy' device which has thermal properties and creates a sensation like picking up a cup of tea.

Dr Merrett adds: "We now have a number of technologies, which we can use to develop sensation. This technology can be used on its own as a stand-alone system to help with sensory rehabilitation or it could be used alongside existing health technologies such as rehabilitation robots or gaming technologies which help patient rehabilitation."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Southampton**.

http://www.sciencedaily.com/releases/2011/04/110405102204.htm

Opioids Now Most Prescribed Class of Medications in America

Prescription pain pills. (Credit: iStockphoto/David Tulk)

ScienceDaily (Apr. 6, 2011) — Two reports by addiction researchers at the University of Pennsylvania School of Medicine and the National Institute on Drug Abuse show a drastic shift in prescribing patterns impacting the magnitude of opioid substance abuse in America. The reports, published in *JAMA*, recommend a comprehensive effort to reduce public health risks while improving patient care, including better training for prescribers, pain management treatment assessment, personal responsibility and public education.

The *JAMA* Research Report shows that there has been a drastic increase in opioid prescriptions while prescriptions for non-steroidal anti-inflammatory drugs (NSAIDs) have gone down. Prescriptions for hydrocodone and oxycodone account for 84.9 percent of opioid prescriptions. Over ten years, there has been a fivefold increase in admissions to substance abuse programs for opioid addiction.

While effective at reducing pain symptoms, opioid medications such as hydrocodone and oxycodone are associated with high rates of abuse, particularly among young adults. One in four 18-25 year olds will abuse prescription pain killers in their lifetime.

Researchers suggest targeting the relatively high rate of prescriptions to adolescents and young adults, who received 11.7 percent of the 202 million opioid prescriptions in the United States during 2009. A large share of the prescriptions to young adults was from dentists, and researchers believe there is a need for medical professionals to evaluate alternative pain medications in this particularly vulnerable age group.

"The scope of the problem is vast -- opioid overdose is now the second leading cause of accidental death in the United States and the prevalence is second only to marijuana," said Thomas McLellan, PhD, co-author of the studies and director of the new Center for Substance Abuse Solutions, housed in the Department of Psychiatry at the University of Pennsylvania School of Medicine. "This study provides valuable information about factors contributing to the high rates of opioid analgesics, and identifies areas ripe for intervention."

In the accompanying Commentary, researchers offer recommendations to improve current pain management in primary care while simultaneously decreasing diversion, abuse and overdoses of opioid medication. These recommendations include:

- Comprehensive and contemporary training for pain management care providers -including physicians, nurses, dentists and pharmacists -- covering the latest research advances on pain and addiction and new drug treatment options.
- Supporting the American Pain Society guidelines, which include plans to develop and roll out screening procedures for those at risk for abuse and dependence (e.g. adolescent or young adults, individual or family history of substance abuse history.)
- Increasing public awareness and responsibility of the addiction risks, to curb sharing or theft of the medication within families.

The research was conducted by The National Institute on Drug Abuse, of the National Institutes of Health, while Dr. McLellan was serving as Deputy Director of the United States Office of National Drug Control Policy.

Penn Medicine researchers are already looking into possible solutions to address these issues. Dr. McLellan leads the new Center for Substance Abuse Solutions that will translate addiction research into evidence-based practical applications to be used locally, nationally and globally.

Collaborators from the Penn Pain Medicine Center will partner with Penn's Center for Substance Abuse Solutions and Department of Internal Medicine to develop a "Patient-Centered Medical Home" care model for patients with chronic pain problems. This new process integrates care provided by primary care physicians and specialists in an effort to provide high-quality, comprehensive care to patients. New health care information technology, such as electronic health care records and Internet-based collection of patient outcomes, will be used to improve coordination of care. Researchers hope that Patient-Centered Medical Home model will improve pain care and lower the chances of diversion and abuse of pain medications.

"The research published today clearly demonstrates the risk of harm that pain medications can cause when used incorrectly," said Michael Ashburn, MD, MPH, MBA, professor of Anesthesiology and Critical Care and director of Pain Medicine at the University of Pennsylvania School of Medicine. "We hope our efforts will demonstrate that improvements can be made to the patient care process and lead to improved pain control and a lower risk of abuse and diversion of these medications."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Pennsylvania School of Medicine**.

Journal References:

1. Nora D. Volkow, Thomas A. Mclellan, Jessica H. Cotto, Meena Karithanom, Susan R. B. Weiss. **Characteristics of Opioid Prescriptions in 2009**. *JAMA*, 2011; 305 (13): 1299-1301 DOI: 10.1001/jama.2011.401
2. Nora D. Volkow, Thomas A. Mclellan. **Curtailing Diversion and Abuse of Opioid Analgesics Without Jeopardizing Pain Treatment**. *JAMA*, 2011; 305 (13): 1346-1347 DOI: 10.1001/jama.2011.369

http://www.sciencedaily.com/releases/2011/04/110405161906.htm

New Studies Link Hunting to Lead in Scavenger Birds

One study, the first to examine the effects of the 2008 law on any wild animals, found that the lead-ammunition ban in California condor range reduced lead exposure in golden eagles such as the one being readied for release by Nick Todd. (Credit: Terra Kelly)

ScienceDaily (Apr. 6, 2011) — Two new UC Davis studies add scientific evidence that hunters' lead ammunition often finds its way into carrion-eating birds, such as eagles and turkey vultures. These scavenger species often take advantage of animal remains left behind when a hunter cleans a kill or when a shot deer or wild pig escapes the hunter but dies later.

However, when the remains contain lead shot pellets or bullet fragments, the scavenger birds can develop lead poisoning, which can cause inability to fly, starvation, anemia, blindness, seizures and death.

In 1991, to protect bald eagles, lead ammunition was banned in the United States for hunting waterfowl. In 2008, to protect California condors, lead ammunition was similarly banned in California condor range for most hunting activities.

One of the new UC Davis studies found direct evidence that lead levels rose in turkey vultures during deer hunts and in areas with wild pig hunts. This was the first-ever investigation of blood lead levels in free-flying turkey vultures.

The other study, the first to examine the effects of the 2008 law on any wild animals, found that the lead-ammunition ban in California condor range reduced lead exposure in golden eagles and turkey vultures in 2009.

The studies were led by Christine Johnson, a UC Davis associate professor of veterinary medicine and an expert on wildlife health, and her doctoral student Terra Kelly, a wildlife veterinarian earning a Ph.D. in epidemiology.

"Hunting is an irreplaceable tool for wildlife management," said Johnson, "especially now that we have fewer large predators but more invasive species like wild pigs. Yet we know that accidental consumption of lead can make animals and people sick.

"It just makes good sense to use non-toxic ammunition, wherever it is available, to protect wildlife as well as eliminate any potential risk to hunters and their families," she concluded.

Both studies were funded by the California Department of Fish and Game. They were published online April 6 by the journal *PLoS ONE*.

Kelly and Johnson are the authors on the study investigating lead exposure in turkey vultures. Their co-authors on the study to evaluate the impact of the lead ammunition ban are: UC Davis research technician Yvette Hernandez, wildlife toxicologist Robert Poppenga and wildlife health expert Walter Boyce; Peter Bloom, a raptor biologist with the University of Idaho; and Steve Torres, a wildlife expert with the California Department of Fish and Game.

Next month, Johnson and Kelly (who is now a UC Davis Wildlife Health Center veterinarian) will begin a similar study to investigate the impacts of ongoing lead exposure on the endangered California condor population.

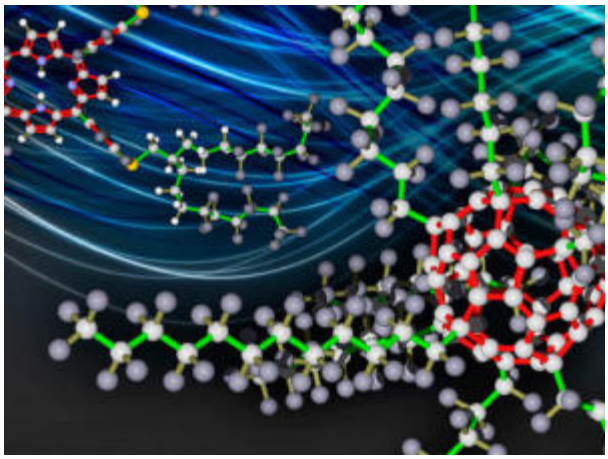
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of California - Davis**.

Journal Reference:

1. Terra R. Kelly, Christine K. Johnson. **Lead Exposure in Free-Flying Turkey Vultures Is Associated with Big Game Hunting in California**. *PLoS ONE*, 2011; 6 (4): e15350 DOI: 10.1371/journal.pone.0015350

http://www.sciencedaily.com/releases/2011/04/110407092046.htm

The 'Molecular Octopus': A Little Brother of 'Schroedinger's Cat'



Artistic view of the most complex and massive molecules (PFNS-10, TPP-152) brought to quantum interference. (Credit: Illustration by Mathias Tomandl)

ScienceDaily (Apr. 6, 2011) — For the first time, the quantum behaviour of molecules consisting of more than 400 atoms was demonstrated by quantum physicists based at the University of Vienna in collaboration with chemists from Basel and Delaware. The international and interdisciplinary team of scientists has set a new record in the verification of the quantum properties of nanoparticles.

In addition, an important aspect of the famous thought experiment known as 'Schroedinger's cat' is probed. However, due to the particular shape of the chosen molecules the reported experiment could be more fittingly called 'molecular octopus'.

The researchers report their findings in *Nature Communications*.

'Schroedinger's cat': simultaneously dead and alive?

Since the beginning of the 20th century, quantum mechanics has been a pillar of modern physics. Still, some of its predictions seem to disagree with our common sense and the observations in our everyday life. This contradiction was brought to the fore 80 years ago by the Austrian physicist Erwin Schroedinger; he wondered whether it was possible to realize states of extreme superposition such as, for example, that of a cat which is simultaneously dead and alive. This experiment has not been realized with actual cats for good reasons. Nevertheless, the successful experiments by Gerlich et al. show that it is possible to reproduce important aspects of this thought experiment with large organic molecules.

'Superposition' demonstrated for larger and larger molecules

In quantum physics, the propagation of massive particles is described by means of matter waves. In a certain sense, this means that the particles loose their classical property of a well-defined position and their quantum wave function can extend simultaneously over a large area. Formally, this state resembles that of a cat that is at the same time dead and alive. In quantum physics this is called a 'superposition'. Markus Arndt and his team at the University of Vienna tackle the question, up to which degree of complexity the amazing laws of quantum physics still apply. To this end, they investigate the quantum behaviour of molecules of increasing size, in particular their superposition at various positions in an interferometer. The high instability of most organic complexes, however, poses a major challenge in the process.

Tailor-made molecules solve the problem of instability

Many molecules break apart during the preparation of the thermal particle beam. Therefore, a close collaboration with chemists from Switzerland and the United States was crucial for the success of the recent experiments. The team of Marcel Mayor at the University of Basel and Paul J. Fagan from Central Research and Development of DuPont in Wilmington, DE, accomplished the synthesis of massive molecule complexes, which can survive the critical evaporation process.

A new record

The use of specifically synthesized organic molecules consisting of complexes of up to 430 atoms enabled the researchers to demonstrate the quantum wave nature in mass and size regimes that hitherto had been

experimentally inaccessible. These particles are comparable in size, mass and complexity to Insulin molecules and exhibit many features of classical objects. Nevertheless, in the current experiment the tailor-made molecules can exist in a superposition of clearly distinguishable positions and therefore -- similar to 'Schroedinger's cat' -- in a state that is excluded in classical physics.

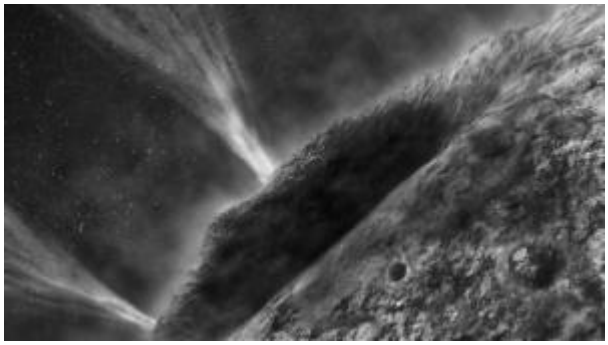
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Vienna**.

Journal Reference:

1. Stefan Gerlich, Sandra Eibenberger, Mathias Tomandl, Stefan Nimmrichter, Klaus Hornberger, Paul J. Fagan, Jens Tüxen, Marcel Mayor, Markus Arndt. **Quantum interference of large organic molecules**. *Nature Communications*, 2011; 2: 263 DOI: 10.1038/ncomms1263

http://www.sciencedaily.com/releases/2011/04/110405151213.htm

Frozen Comet's Watery Past: Discovery Challenges Paradigm of Comets as 'Dirty Snowballs' Frozen in Time



This artist's impression shows the irregular surface of comet Wild-2 and jets spouting into space at speeds of several hundred kilometers per hour. A UA-led team of scientists now found evidence that Wild-2 harbored liquid water at some point in its history. (Credit: NASA/JPL-Caltech)

ScienceDaily (Apr. 6, 2011) — For the first time, scientists have found convincing evidence for the presence of liquid water in a comet, shattering the current paradigm that comets never get warm enough to melt the ice that makes up the bulk of their material.

"Current thinking suggests that it is impossible to form liquid water inside of a comet," said Dante Lauretta, an associate professor of cosmochemistry and planet formation at the UA's Lunar and Planetary Laboratory. Lauretta is the principal investigator of the UA team involved in analysis of samples returned by NASA's Stardust mission.

UA graduate student Eve Berger, who led the study, and her colleagues from Johnson Space Center and the Naval Research Laboratory made the discovery analyzing dust grains brought back to Earth from comet Wild-2 as part of the Stardust mission. Launched in 1999, the Stardust spacecraft scooped up tiny particles released from the comet's surface in 2004 and brought them back to Earth in a capsule that landed in Utah two years later.

"In our samples, we found minerals that formed in the presence of liquid water," Berger said. "At some point in its history, the comet must have harbored pockets of water."

The discovery is to be published in an upcoming online edition of the journal *Geochimica et Cosmochimica Acta*.

Comets are frequently called dirty snowballs because they consist of mostly water ice, peppered with rocky debris and frozen gases. Unlike asteroids, extraterrestrial chunks made up of rock and minerals, comets sport a tail -- jets of gas and vapor that the high-energy particle stream coming from the sun flushes out of their frozen bodies.

"When the ice melted on Wild-2, the resulting warm water dissolved minerals that were present at the time and precipitated the iron and copper sulfide minerals we observed in our study," Lauretta said. "The sulfide minerals formed between 50 and 200 degrees Celsius (122 and 392 degrees Fahrenheit), much warmer than the sub-zero temperatures predicted for the interior of a comet."

Discovered in 1978 by Swiss astronomer Paul Wild, Wild-2 (pronounced "Vilt") had traveled the outer reaches of the solar system for most of its 4.5 billion year history, until a close encounter with Jupiter's field of gravity sent the 3.4 mile-wide comet onto a new, highly elliptical orbit bringing it closer to the sun and the inner planets.

Scientists believe that like many other comets, Wild-2 originated in the Kuiper belt, a region extending from beyond Neptune's orbit into deep space, containing icy debris left over from the formation of the solar system. Wild-2 is thought to have spent most of its time in the Kuiper belt, transiting on unstable orbits within the planetary system before Jupiter's gravity hurled it into the neighborhood of the sun.

The discovery of the low-temperature sulfide minerals is important for our understanding of how comets formed -- which in turn tells us about the origin of the solar system.

In addition to providing evidence of liquid water, the discovered ingredients put an upper limit to the temperatures Wild-2 encountered during its origin and history.

"The mineral we found -- cubanite -- is very rare in sample collections from space," Berger said. "It comes in two forms -- the one we found only exists below 210 degrees Celsius (99 degrees Fahrenheit). This is exciting because it tells us those grains have not seen temperatures higher than that. "

Cubanite is a copper iron sulfide, which is also found in ore deposits on Earth exposed to heated groundwater and in a particular type of meteorite.

"Wherever the cubanite formed, it stayed cool," she added. "If this mineral formed on the comet, it has implications for heat sources on comets in general."

According to Berger, two ways to generate heat sources on comets are minor collisions with other objects and radioactive decay of elements present in the comet's mixture.

Heat generated at the site of minor impacts might generate pockets of water in which the sulfides could form very quickly, within about a year (as opposed to millions of years). This could happen at any point in the comet's history. Radioactive decay on the other hand, would point to a very early formation of the minerals since the radioactive nuclides would decay over time and cause the heat source to flicker out.

The presence of the cubanite and the other sulfide minerals helps scientists better understand cometary heat sources. The interior of the comet must have been warm enough to melt ice yet cool enough -- below 210 degrees Celsius -- to form cubanite.

"Such detailed thermal constraints will allow for detailed analysis of the role temperature played during the history of comet Wild 2," Lauretta said.

Each sample Berger's team analyzed consisted of a microscopic speck of cometary dust about the size of a bacterial cell. The group then studied the chemical composition by electron microscopy and X-ray analysis, during which the chemical elements revealed their presence by giving off a characteristic beam. Turning the sample in different orientations gave the scientists clues about its crystallographic structure.

According to Lauretta, the findings show that comets experienced processes such as heating and chemical reactions in liquid water that changed the minerals they inherited from the time when the solar system was still a protoplanetary disk, a swirling mix of hot gases and dust, before it cooled down enough for planets to form.

The results demonstrate the increasingly apparent connections between comets and asteroids.

"What we found makes us look at comets in a different way," Lauretta said. "We think they should be viewed as individual entities with their own unique geologic history."

"This study shows the high science value of sample return missions," Lauretta said. "These grains would never been detected by remote sensing or by flying a spacecraft past the comet to make observations without collecting a sample."

Lauretta believes so strongly in the value of sample return missions that he has spent the past seven years developing the OSIRIS-REx Asteroid Sample Return mission, which is currently a finalist in the NASA New Frontiers mission competition. Selections are expected in early June.

Story Source:

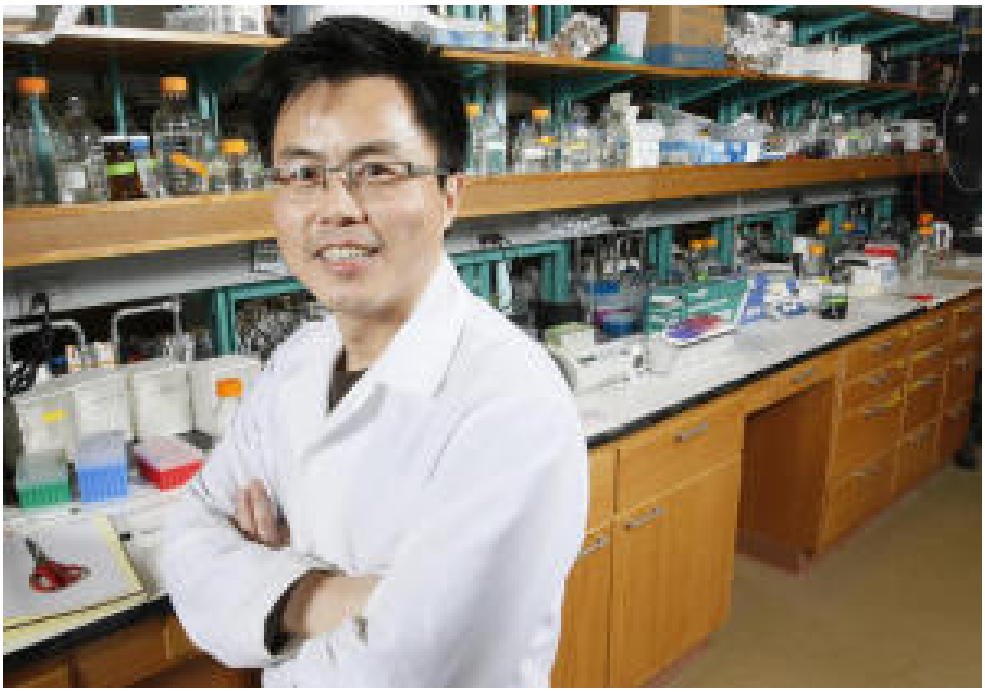
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Arizona**. The original article was written by Daniel Stolte, University Communications.

Journal Reference:

1. Eve L. Berger, Thomas J. Zega, Lindsay P. Keller, Dante S. Lauretta. **Evidence for aqueous activity on comet 81P/Wild 2 from sulfide mineral assemblages in Stardust samples and CI chondrites**. *Geochimica et Cosmochimica Acta*, 2011; DOI: 10.1016/j.gca.2011.03.026

http://www.sciencedaily.com/releases/2011/04/110405175018.htm

Nanopolymer Shows Promise for Helping Reduce Cancer Side Effects



W. Andy Tao's nanopolymers can better assess whether cancer drugs are reaching their targets, a development that may reduce the side effects of those drugs. (Credit: Purdue Agricultural Communication photo/Tom Campbell)

ScienceDaily (Apr. 6, 2011) — A Purdue University biochemist has demonstrated a process using nanotechnology to better assess whether cancer drugs hit their targets, which may help reduce drug side effects.

W. Andy Tao, an associate professor of biochemistry analytical chemistry, developed a nanopolymer that can be coated with drugs, enter cells and then removed to determine which proteins in the cells the drug has entered. Since they're water-soluble, Tao believes the nanopolymers also may be a better delivery system for drugs that do not dissolve in water effectively.

"Many cancer drugs are not very specific. They target many different proteins," said Tao, whose findings were published in the early online in the journal *Agnewandte Chemie International Edition*. "That can have a consequence -- what we call side effects."

In addition to the drug, the synthetic nanopolymer is equipped with a chemical group that is reactive to small beads. The beads retrieve the nanopolymer and any attached proteins after the drug has done its work. Tao uses mass spectrometry to determine which proteins are present and have been targeted by the drug.

Knowing which proteins are targeted would allow drug developers to test whether new drugs target only desired proteins or others as well. Eliminating unintended protein targets could reduce the often-serious side effects associated with cancer drugs.

Tao said there currently is no reliable way to test drugs for off-targeting. He said drugs are often designed to inhibit or activate the function of a biomolecule associated with cancer, but those drugs tend to fail in late-stage clinical tests.

Tao also believes his nanopolymers could better deliver drugs to their targets. Since they are nanosized and water soluble, the nanopolymers could gain access to cells more effectively than a standalone drug that is only minimally water-soluble.

Tao demonstrated the nanopolymer's abilities using human cancer cells and the cancer drug methotrexate. The nanopolymers were tracked using a fluorescent dye to show they were entering cells. Then, Tao broke the cells and retrieved the nanopolymers.

Tao has shown the nanopolymer's ability using a metabolic drug, which are small, low-cost drugs but are less target specific and have more side-effects. He now plans to do the same using drugs that are based on synthetic peptides, which are larger and more expensive but more specific and with fewer side effects.
The National Institutes of Health's National Center for Research Resources and a National Science Foundation Career Grant funded the research.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Purdue University**. The original article was written by Brian Wallheimer.

Journal Reference:

1. Lianghai Hu, Anton Iliuk, Jacob Galan, Michael Hans, W. Andy Tao. **Identification of Drug Targets In Vitro and in Living Cells by Soluble-Nanopolymer-Based Proteomics**. *Angewandte Chemie International Edition*, 2011; DOI: 10.1002/anie.201006459

http://www.sciencedaily.com/releases/2011/04/110405151216.htm

Neanderthals: Bad luck and its part in their downfall

- 07 April 2011 by **Mark Buchanan**
- Magazine issue 2807.

No hard feelings, cousin (Image: Frank Franklin II/AP/PA)

AS OUR ancestors moved north out of Africa and onto the doorstep to the rest of the world, they came across their long-lost cousins: the Neanderthals. As the popular story goes, the brutish hominins were simply no match for cultured, intelligent *Homo sapiens* and quickly went extinct.

Maybe, but it's also possible that Neanderthals were simply unlucky and disappeared by chance, mathematicians propose.

We know that humans and Neanderthals got pretty cosy during their time together in the Middle East, 45,000 years ago. Between 1 and 4 per cent of the DNA of modern non-Africans is of Neanderthal origin, implying their ancestors must have interbred before humans moved into Europe (*New Scientist*, 15 May 2010, p 8).

The popular theory has it that humans soon displaced Neanderthals thanks to their superior skills and adaptations. But mathematicians Armando Neves at the Federal University of Minas Gerais in Belo Horizonte, Brazil, and Maurizio Serva at the University of Aquila, Italy, now say that the extinction of Neanderthals may have been down to a genetic lottery.

When two populations interbreed, one of them can go extinct simply due to the random mixing of their genes through sexual reproduction.

To find out if this could have wiped out Neanderthals, Neves and Serva modelled the populations that met in the Middle East. Using very few assumptions, they estimated the rate of interbreeding that would lead to the observed share of Neanderthal DNA.

Their results suggest that the 1 to 4 per cent genetic mix could have come about with one interbreeding every 10 to 80 generations. The time taken to reach this mix would depend on the size of the populations. But regardless of populations, Neves and Serva's model shows that low rates of interbreeding could theoretically have led to the extinction of Neanderthals through a genetic lottery (arxiv.org/abs/1103.4621).

"The observed low fraction of Neanderthal DNA could easily have arisen quite naturally even if Neanderthals weren't inferior," says Neves.

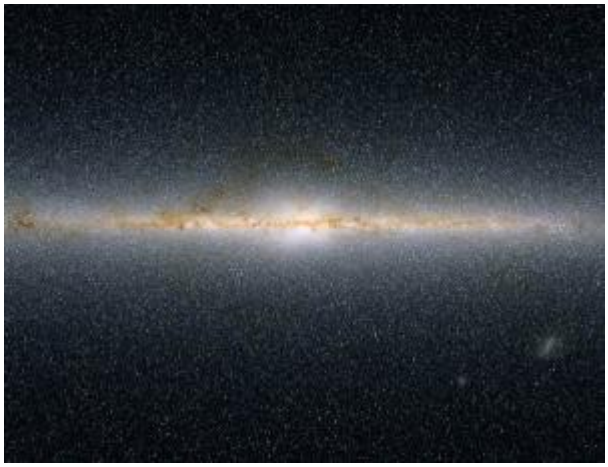
A strong point of the analysis, says anthropologist Luke Premo of the University of Washington in Pullman, is that it makes few assumptions about unknown factors, including the relative sizes of the African and Neanderthal populations at the time.

Nevertheless, says Premo, the evidence for some kind of superiority of the African group is still strong. "Humans were expanding while Neanderthals were fairly restricted to a portion of Eurasia," he says. "Given their larger population and expansion, it appears that humans were bound to win out."

http://www.newscientist.com/article/mg21028073.400-neanderthals-bad-luck-and-its-part-in-their-downfall.html?full=true&print=true

Dark matter could make planets habitable

- 20:58 30 March 2011 by **Maggie McKee**



Near the centre of the Milky Way, planets may be heated by dark matter (Image: 2MASS/J. Carpenter/T. H. Jarrett/R. Hurt)

Enlarge image

Dark matter could make planets that would otherwise be hostile to life habitable, a new study suggests. It suggests that in areas rich in dark matter, particles of the stuff could collect inside free-floating planets that have no star to warm them, heating them enough to maintain liquid water on their surfaces.

No one knows what dark matter is – astronomers merely detect its gravitational pull on normal matter, which it seems to outweigh by a factor of five to one. But many researchers believe it is made of particles called WIMPs, which interact only weakly with normal matter but annihilate on contact with each other, creating a spray of energetic particles.

This annihilation could produce heat if the particles were absorbed by surrounding matter. Now, Dan Hooper and Jason Steffen of Fermilab in Batavia, Illinois, have calculated how much heat would be produced inside planets in different dark matter environments.

Gravitationally captured

For decades, theorists have calculated that dark matter could be gravitationally captured by planets and stars. Dark matter surrounds galaxies in so-called halos, and dark matter particles, feeling the force of gravity, orbit their galaxy's centre of mass.

When these orbiting dark matter particles pass through objects, such as planets, they occasionally slam into atoms, losing energy and speed. If they lose enough energy after one or more collisions, they could become trapped by the planet's gravity, ultimately settling in its core. There, they are likely to hit other trapped dark matter particles and annihilate.

Is annihilating dark matter heating up the Earth? Not appreciably, say the authors. The Earth lies about 26,000 light years from the centre of the galaxy, far enough away that the concentration of dark matter is too low to have much of an effect.

The power produced by annihilating dark matter "is something like a megawatt – small by power-plant standards", says Hooper. "One power plant in the middle of the Earth isn't going to matter very much." By contrast, the Earth absorbs about 100 billion megawatts of power from sunlight.

'Sustainable energy'

But closer to the centre of the galaxy, the concentration of dark matter is much higher – so this heating could approach the heat that Earth receives from sunlight. The researchers found that a planet weighing a few times the mass of the Earth, lying within about 30 light years from the galactic centre, could be heated enough by dark matter alone to maintain liquid water on its surface.

That would mean that any planets that had broken away from their host stars in gravitational tussles with neighbours could be habitable, even though they were floating through cold space.
And the heating would continue for trillions of years, since dark matter would continually be captured by the planets' gravity. "This is the ultimate form of sustainable energy," Hooper told *New Scientist*.

Last bastion

That could come in handy far into the future, when stars have exhausted their nuclear fuel and died. "Trillions of years into the future, you might have some remnant advanced civilization that is looking for a new home because their star shopped shining," says Hooper. "Where would they go? They might choose to migrate to dark-matter-heated planets. They might be the last bastion of life in the very distant future of our galaxy."
That may be so, but Dave Stevenson of Caltech in Pasadena, California, points out that planets where dark matter would provide significant heating are extremely rare.
"You have to go to a place where the dark matter density is 10 million times larger than the usual estimate [in Earth's neighbourhood]," he says. "They're talking about a tiny fraction of possible cases."

Not testable?

"It's a very creative idea," says James Kasting of Pennsylvania State University in University Park. "But it's not really testable."
That's because these dark-matter-rich areas are so far away – 26,000 light years – that even if the presence of planets could be detected, current and planned telescopes would not be able to image them, looking for signs of water.
"We're most interested in stars within about [65 or 100 light years] of the Earth because we think we can build a big telescope sometime within the next 20 years to try to image planets around them," Kasting told *New Scientist*.
But Hooper says dark matter detection experiments on Earth could provide a test of sorts. His calculations are based on WIMP candidates that interact as strongly with normal matter as is allowed by current observations. If experiments fail to detect dark matter in the next five to 10 years, then that will suggest dark mater does not interact strongly enough to produce much planetary heating, he says.
If dark matter does interact as Hooper and Steffen have calculated, though, it could produce too much heat for life to survive on some planets, frying those that are also getting heat from their host stars. "If the planet was getting the same amount of starlight that the Earth does, and you added an equivalent energy coming from below, you'd go into the runaway greenhouse case," Kasting says. "You'd lose the water and end up with a planet like Venus."
Gregory Laughlin of the University of California, Santa Cruz, agrees with Kasting that these planets would be extremely difficult to detect: "I think it's going to remain strictly a theoretical curiosity for quite a while."
Journal reference: arxiv.org/abs/1103.5086

http://www.newscientist.com/article/dn20320-dark-matter-could-make-planets-habitable.html

SpaceX plans world's most powerful rocket

20:51 5 April 2011
Space
David Shiga, reporter

(Image: SpaceX)

California-based SpaceX has announced plans for a new rocket that it says will be the most powerful in the world.

Headed by PayPal co-founder Elon Musk, SpaceX has already successfully flown two other rockets, the Falcon 1 and Falcon 9. It has a NASA contract to deliver cargo to the International Space Station using the Falcon 9 and Dragon space capsule.

Today Musk announced plans for a much more powerful rocket called the Falcon Heavy in a press briefing in Washington DC.

It will be able to lift 53 tonnes to low Earth orbit, more than any other rocket in existence. Only one other rocket in history has ever been able to lift more: The Saturn V rockets, used by NASA to send astronauts to the moon, could each lift 118 tonnes to low Earth orbit.

"This opens a new world of capability for both government and commercial space missions," Musk said.

The company plans to launch the rocket for the first time in 2013 or 2014 on a test flight.

SpaceX plans to use the rocket to carry satellites to geosynchronous orbit and one day, perhaps to send astronauts to the moon or Mars (though multiple launches would be needed to loft all the necessary hardware for each mission).

In the nearer term, SpaceX hopes to win a NASA contract to carry astronauts to the space station on its smaller Falcon 9 rocket, which is powerful enough to lift a Dragon capsule containing seven people.

But the results of a study by the non-profit Aerospace Corporation, posted yesterday on the NASA Watch website, say seats on such commercial space taxis would probably cost two to three times as much as those on Russian Soyuz capsules. NASA plans initially to buy seats on Soyuz capsules for flights to the space station after the space shuttle fleet's planned retirement this year.

The Commercial Spaceflight Federation, a lobbying group for space companies, countered that the study was based on inaccurate information, including the assumption that space taxis could carry only four astronauts at a time.

http://www.newscientist.com/blogs/shortsharpscience/2011/04/spacex-plans-worlds-most-power.html

Mystery signal at Fermilab hints at 'technicolour' force

- 19:46 07 April 2011 by **Amanda Gefter**

Hints of new physics at the Tevatron (Image: Fermilab)

The physics world is buzzing with news of an unexpected sighting at Fermilab's Tevatron collider in Illinois – a glimpse of an unidentified particle that, should it prove to be real, will radically alter physicists' prevailing ideas about how nature works and how particles get their mass.

The candidate particle may not belong to the standard model of particle physics, physicists' best theory for how particles and forces interact. Instead, some say it might be the first hint of a new force of nature, called technicolour, which would resolve some problems with the standard model but would leave others unanswered.

The observation was made by Fermilab's CDF experiment, which smashes together protons and antiprotons 2 million times every second. The data, collected over a span of eight years, looks at collisions that produce a W boson, the carrier of the weak nuclear force, and a pair of jets of subatomic particles called quarks. Physicists predicted that the number of these events – producing a W boson and a pair of jets – would fall off as the mass of the jet pair increased. But the CDF data showed something strange (see graph): a bump in the number of events when the mass of the jet pair was about 145 GeV.

Just a fluke?

That suggests that the additional jet pairs were produced by a new particle weighing about 145 GeV. "We expected to see a smooth shape that decreases for increasing values of the mass," says CDF team member Pierluigi Catastini of Harvard University in Cambridge, Massachusetts. "Instead we observe an excess of events concentrated in one region, and it seems to be a bump – the typical signature of a particle."

Intriguing as it sounds, there is a 1 in 1000 chance that the bump is simply a statistical fluke. Those odds make it a so-called three-sigma result, falling short of the gold standard for a discovery – five sigma, or a 1 in a million chance of error. "I've seen three-sigma effects come and go," says Kenneth Lane of Boston University in Massachusetts. Still, physicists are 99.9 per cent sure it is not a fluke, so they are understandably anxious to pin down the particle's identity.

Most agree that the mysterious particle is not the long-sought Higgs boson, believed by many to endow particles with mass. "It's definitely not a Higgs-like object," says Rob Roser, a CDF spokesperson at Fermilab. If it were, the bump in the data would be 300 times smaller. What's more, a Higgs particle should most often decay into bottom quarks, which do not seem to make an appearance in the Fermilab data.

Fifth force

"There's no version of a Higgs in any model that I know of where the production rate would be this large," says Lane. "It has to be something else." And Lane is confident that he knows exactly what it is.

Just over 20 years ago, Lane, along with Fermilab physicist Estia Eichten, predicted that experiments would see just such a signal. Lane and Eichten were working on a theory known as technicolour, which proposes the existence of a fifth fundamental force in addition to the four already known: gravity, electromagnetism, and

the strong and weak nuclear forces. Technicolour is very similar to the strong force, which binds quarks together in the nuclei of atoms, only it operates at much higher energies. It is also able to give particles their mass – rendering the Higgs boson unnecessary.
The new force comes with a zoo of new particles. Lane and Eichten's model predicted that a technicolour particle called a technirho would often decay into a W boson and another particle called a technipion.
In a new paper, Lane, Eichten and Fermilab physicist Adam Martin suggest that a technipion with a mass of about 160 GeV could be the mysterious particle producing the two jets. "If this is real, I think people will give up on the idea of looking for the Higgs and begin exploring this rich world of new particles," Lane says.

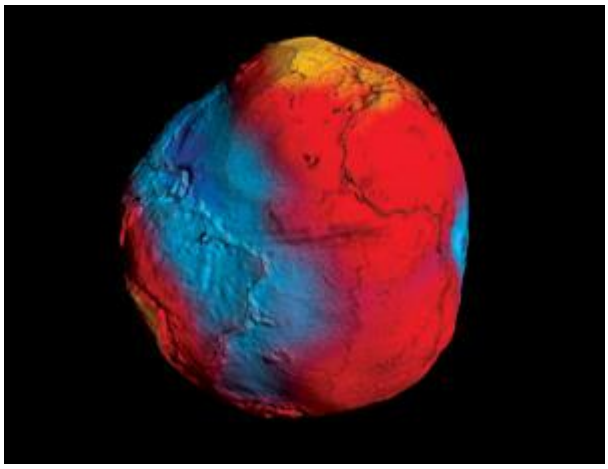
Future tests

But if technicolour is correct, it would not be able to resolve all the questions left unanswered by the standard model. For example, physicists believe that at the high energies found in the early universe, the fundamental forces of nature were unified into a single superforce. Supersymmetry, physicists' leading contender for a theory beyond the standard model, paves a way for the forces to unite at high energies, but technicolour does not.
Figuring out which theory – if either – is right means combing through more heaps of data to determine if the new signal is real. Budget constraints mean the Tevatron will shut down this year, but fortunately the CDF team, which made the find, is already "sitting on almost twice the data that went into this analysis", says Roser. "Over the coming months we will redo the analysis with double the data."
Meanwhile, DZero, Fermilab's other detector, will analyse its own data to provide independent corroboration or refutation of the bump. And at CERN's Large Hadron Collider near Geneva, Switzerland, physicists will soon collect enough data to perform their own search. In their paper, Lane and his colleagues suggest ways to look for other techniparticles.
"I haven't been sleeping very well for the past six months," says Lane, who found out about the bump long before the team went public with the result. "If this is what we think it is, it's a whole new world beyond quarks and leptons. It'll be great! And if it's not, it's not."
Journal reference: arxiv.org/abs/1104.0699

http://www.newscientist.com/article/dn20357-mystery-signal-at-fermilab-hints-at-technicolour-force.html

Earth is shaped like a lumpy potato

- 15:08 05 April 2011 by **Ferris Jabr**



Earth's high spots show up dramatically when magnified x7000 (Image: ESA/HPF/DLR)

A sleek satellite orbiting Earth has confirmed that the planet is not the simple squashed sphere we often imagine it to be. It is, in fact, more like a lumpy potato.

Nearly a year's worth of gravitational measurements from the European Space Agency's Gravity Field and Steady-State Ocean Circulation Explorer (GOCE) have yielded a colourful map portraying the geoid – the shape the Earth's surface would be if it was entirely covered by water and influenced by gravity alone.

The result is not a smooth sphere because mass is not distributed evenly within the Earth's mantle. Different parts of the globe exert a different gravitational pull on the ocean, meaning that sea level is lower than expected in some places – represented by blue patches – and higher than expected in others – the red and yellow areas.

In the visualisation, the vertical scale has been exaggerated by a factor of 7000, so the pits and crests are 7000 times shallower or taller, respectively, than depicted here.

No wind, no tides

The visualisation shows true sea level, liberated from the artefacts of tides and winds. Mission scientist Roger Haagmans explains the influence of winds on the oceans through a simple model: suppose you have a bathtub full of water and you place a fan on one side to blow the surface: the water will pile up on the opposite side. Now shut the fan off, and the water will settle at a new level, according to gravity.

The new geoid map will be useful for studying ocean circulation, ice dynamics, sea-level change and earthquakes. "We want to have a system to describe the actual ocean currents, how all the currents actually are in the absolute sense, because they transport heat and influence climate," Haagmans says. "When we get more data we can make the final model more accurate and map the smallest currents."

Launched in March 2009, the 5-metre-long GOCE holds six sensitive accelerometers. This allows gravity to be measured with great precision as the satellite circles Earth at an altitude of approximately 255 kilometres. GOCE carries enough fuel to continue operating until the end of 2012.

http://www.newscientist.com/article/dn20335-earth-is-shaped-like-a-lumpy-potato.html?full=true&print=true

Empty universe: Cosmology in the year 100 billion

- 04 April 2011 by **Marcus Chown**
- Magazine issue 2806.

Lonesome galaxy (Image: Larry Landolfi/SPL)

The skies of the far future will be dark and lonely, but our descendants will have one telltale clue to help them decipher the cosmos

ONCE, long ago, we shared the universe with 100 billion galaxies. Now only a single island of stars remains, floating in an unutterably vast, unutterably empty ocean of space. This is a vision of the Milky Way when the cosmos is 10 times older than it is today.

The perpetrator of this desperately lonely future is dark energy, the mysterious force that is accelerating the expansion of the cosmos. Billions of years from now, the expansion will drive all the other galaxies over the cosmic horizon where their light can never reach us. Ours will be the only galaxy left in the observable universe.

So disturbing is this image that some researchers have been toying with the idea of moving the galaxy to a more hospitable neighbourhood. Others are more sanguine about our fate and are exploring what, if anything, cosmologists of the future will be able to tell about the universe they live in.

We live at a fortunate time in cosmic history because we can gaze through telescopes at a night sky ablaze with the beacons of billions of galaxies. By charting how fast these galaxies are receding we have inferred that the universe was smaller in the past and that it burst into being 13.7 billion years ago in an explosion called the big bang.

Had we come on the scene in the year 100 billion or so, how would we figure out where the universe had come from with no other galaxies to help us? Surely the science of cosmology would be impossible.

Or would it? Last October, Abraham Loeb of the Centre for Astrophysics at Harvard University gave a public lecture about the long-term future of the universe. He pointed out that the laws of physics and cosmology are so accurate, we can predict what will happen to the universe billions of years from now.

After his lecture, many people asked whether intelligent life - if it still exists - would be able to figure out as much about the universe as we have. Loeb was intrigued. So, on a day free of teaching, he sat down with a pen and paper to explore the idea.

He quickly concluded that most astronomers have been too pessimistic. Incredibly, there will be a way to do cosmology beyond AD 100 billion. Admittedly, it will not be as easy as today. But it will not be impossible.

"When there are no longer galaxies to use as indicators of cosmic expansion, another type of celestial body steps up to the plate," says Loeb.

To find out what it is, you first need to follow what will happen to the universe and, in particular, our galaxy over hundreds of billions of years. Over this enormous span of time, two principal things will happen to the Milky Way - one dramatic and one not so dramatic but equally profound in its consequences.

The drama will come courtesy of our neighbouring galaxy, Andromeda, which is currently plunging towards us in a journey orchestrated by gravity. Over the next few billion years, the giant spiral galaxy will loom larger and larger in our night sky, until we can see two bands of stars instead of just the one making up the Milky Way.

In 2.3 billion years' time, Andromeda will fly past the Milky Way. Its gravity will do little more than ruffle the stars in our galaxy but this is a mere dress rehearsal for the main event. Like a pendulum overshooting its lowest point and swinging back, in 5 billion years' time, Andromeda will return. And this time it will collide catastrophically with the Milky Way.

As a result, the supermassive black holes at the centre of the two galaxies will merge and the motion of the stars surrounding them will be thrown into chaos. "Where once there were two spiral galaxies, there will now be a spherical swarm of stars," Loeb says. "In the turmoil, the sun will be kicked from its position 26,000 light years from the centre out to about 60,000 light years."

Loeb and others have dubbed the merged elliptical galaxy Milkomeda. It is here that the massive, bright stars will burn out and die, including our very own sun. By 5 billion years from now, it will have exhausted all its nuclear fuel and be unrecognisable as our life-giving star. It will have swollen into a red giant, possibly swallowed the Earth, then dwindled to an Earth-sized stellar ember, slowly fading from view. "By this time, our descendants, if they still exist, will have long left the planet," Loeb says.

Fortunately, there is no shortage of alternative accommodation. About 70 per cent of stars are cool low-mass stars called red dwarfs. So miserly with their fuel are these red dwarfs that they easily burn for 10,000 billion years. "And they have habitable zones where planets might support life," says Loeb.

The view from a planet orbiting a red dwarf in AD 100 billion would be very different from our night sky. Whereas several thousand stars are visible from Earth with the naked eye, not a single one would be bright enough to pierce the darkness.

Even worse would be the view of the universe through telescopes, or rather the lack of it. Dark energy has a repulsive gravity, which is speeding up the expansion of the universe. Remarkably, dark energy gets stronger as the universe expands. If the universe doubles in volume, the dark energy doubles too, and so on, with dark energy controlling the universe rather than gravity.

Such expansion will drive away every other galaxy, eventually causing them to rush away from us at the speed of light. When this happens, light from other galaxies can never reach us. So astronomers in the year 100 billion will look out on a vast dark wasteland utterly devoid of galaxies. Cosmology would appear to be a hopeless pursuit.

However, Loeb's work shows this needn't be the case. One of his other research interests is a remarkable group of objects called hypervelocity stars. These first came to light in 2005 when Warren Brown, also at Harvard, spotted a young, hot, blue star streaking outward through the halo of the Milky Way at the astonishing speed of 850 kilometres a second. "No new stars are being born in the halo, so it stuck out like a sore thumb," says Loeb. "It was not from there."

The star, already 250,000 light years from the centre of the galaxy, is moving so fast it will escape the gravity of the Milky Way altogether. The only thing that could have boosted it to such a high speed is a close encounter with the supermassive black hole lurking at the centre of our galaxy.

Since the first hypervelocity star came to light, 14 more have been discovered. According to Loeb, our supermassive black hole has been flinging a star out of the galaxy roughly every 100,000 years since the galaxy was born about 10 billion years ago. "Around 100,000 stars have already been ejected," says Loeb. "The earliest ejected ones are already 50 million light years away."

It is these stars, kicked into touch by Milkomeda's supermassive black hole, which Loeb says can play the role of cosmological indicators. Detecting such super-faint stars racing away from Milkomeda will not be easy but, as Loeb wryly observes, the astronomers of the far future will not be short of time. The key is to measure the Doppler shift - the amount by which light from these stars is stretched to longer, redder wavelengths on its journey through space-time. This tells you how much the universe has expanded since the light was emitted. By charting this Doppler shift for hypervelocity stars at different distances, Milkomeda's cosmologists will be able to tell that something is accelerating the universe's expansion - in exactly the same way we found the cosmic acceleration using supernovae explosions in galaxies.

As the universe expands, matter becomes ever more diluted. So future astronomers will be able to infer that matter was far denser in the past and they will be able to work out exactly when dark energy's repulsive force won out over gravity.
Hypervelocity stars will also provide them with important information about Milkomeda itself. Before ejected stars get so far from the galaxy that they are accelerated away by the cosmic expansion, their speed will be braked by the gravity of all the stars and matter in Milkomeda. By observing the deceleration of such stars, it will be possible to deduce the mass and density of Milkomeda.
Will these cosmologists also be able to work out how the universe came into being? Today we can observe the dim afterglow of the big bang fireball. This cosmic microwave background radiation has a characteristic wavelength. "But 1000 billion years from now, it will be stretched from its current value of about 2 millimetres to larger than the observable universe," says Loeb. "It will effectively cease to exist as a cosmic probe."
Incredibly, all is not lost. Loeb points to the light elements - helium, deuterium, lithium and so on. Low-mass stars, which fuse hydrogen into helium in their cores, can at most convert a few per cent of the universe's hydrogen into helium. Yet 25 per cent of the mass of the universe is helium. The only way so much could have formed is if the universe as a whole went through a super-dense, super-hot phase in which there was an orgy of fusion to make helium. So the abundances of light elements in Milkomeda will tell cosmologists that the universe experienced a hot big bang, says Loeb. "Contrary to expectations, astronomers of the future will be perfectly able to piece together the history of the universe," he says.
Fred Adams of the University of Michigan is intrigued by Loeb's idea of using hypervelocity stars as probes of cosmic expansion. However, he points out a flaw in the strategy. "Even the smallest, longest-lived stars will burn out after 10,000 billion years or so," he says. "Then we are out of business again."
Not everyone is as relaxed about the future cosmos as Adams and Loeb. Freeman Dyson of the Institute for Advanced Study in Princeton is appalled by the prospect of living in a future universe with only one, super-dull galaxy. "It presents a dismal picture of the future awaiting our descendants," he says in correspondence with Loeb.
Instead, Dyson speculates whether such a future could be changed by the intervention of intelligent life. He wonders whether a super civilisation might actually be able to move galaxies about by harnessing their gravitational energy. By concentrating them in one giant super-cluster, the inhabitants of these galaxies will at least be able to huddle together as other galaxies disappear over the horizon. "Our descendants would stay in communication with 100 million galaxies instead of only one," says Dyson.
Loeb points out, drolly, that moving galaxies will be very hard indeed. It would be far simpler, he maintains, to identify a large concentration of galaxies, such as the Coma cluster, and go there - although the 320 million-light year journey would be a very long one. "Travelling is a lot easier than cosmic engineering," he says.
Even if our descendants stay within the confines of the galaxy, it will be far from lonely, says Greg Laughlin of the University of California at Santa Cruz. "Milkomeda will contain upwards of 100 billion red dwarf stars and well over 100 billion planets," he says. "That's a lot of worlds to explore, so the future - at least in the 100-billion year 'near-term' - doesn't seem too bleak at all."
Loeb has a final, rather bizarre thought. "My paper is the only one I have ever written that has a chance of being cited in 1000 billion years."

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***Marcus Chown**'s latest book is We Need to Talk About Kelvin (Faber & Faber, 2009*

http://www.newscientist.com/article/mg21028061.400-empty-universe-cosmology-in-the-year-100-billion.html?

Heard it on the grapevine: The secret society of plants

- 29 March 2011 by **Ferris Jabr**
- Magazine issue 2805.

Friend or foe? (Image: Grant Heilman/ALAMY)

The botanical underground is a social network of powerful alliances and nepotism. Decoding its messages could lead to radical change in farms and forests

Every autumn swarms of dusty grey moths engulf the mountainside birch forests of northern Scandinavia, laying their eggs on twigs so that, come springtime, the newly hatched larvae can feast upon budding leaves. It looks like a battle that the trees, with no natural defences, are doomed to lose, but some have a secret weapon. They form an alliance with a neighbouring plant, a kind of rhododendron, borrowing wafts of its volatile insecticides as a sort of olfactory camouflage. "This kind of interaction has never been observed in the field before," says Jarmo Holopainen at the University of Eastern Finland in Kuopio, who made the discovery (*New Phytologist*, vol 186, p 722). His study is one of the latest to demonstrate the unexpectedly complex relationships between plants.

We've known for some time that plants respond to one another, but only now are we realising how subtle and sophisticated their interactions can be. Plants continually eavesdrop on each other's chemical chatter - sometimes sympathetically, sometimes selfishly. Some plants, like the Scandinavian rhododendron, assist their neighbours by sharing resources. Others recognise close relatives and favour them over strangers. And at least one parasitic plant homes in on its host's telltale chemical scent (see "Scent of a victim").

"Plants don't go out to parties or to watch the movies, but they do have a social network," says Suzanne Simard, a forest ecologist at the University of British Columbia in Vancouver, Canada. "They support each other and they fight with each other. The more we look at plant signalling and communication, the more we learn. It's really incredible."

Since the development of time-lapse photography, it has been possible to document the dances and scuffles in densely populated plant communities: saplings on the forest floor compete for space to stretch their roots and shoots; fallen trees provide young ones with nourishment; vines lash around desperately searching for a trunk they can climb to reach the light; and wildflowers race each other to open their blooms in springtime and compete for the attention of pollinators. To truly understand the secret social life of plants, however, you must look and listen more closely.

A good place to start is underground in the rhizosphere - the ecosystem in and around plant roots. Beneath the forest floor, each spoonful of dirt contains millions of tiny organisms. These bacteria and fungi form a symbiotic relationship with plant roots, helping their hosts absorb water and vital elements like nitrogen in return for a steady supply of nutrients.

Now closer inspection has revealed that fungal threads physically unite the roots of dozens of trees, often of different species, into a single mycorrhizal network. These webs sprawled beneath our feet are genuine social networks. By tracing the movement of radioactive carbon isotopes through them, Simard has found that water and nutrients tend to flow from trees that make excess food to ones that don't have enough. One study published in 2009, for example, showed that older Douglas firs transferred molecules containing carbon and nitrogen to saplings of the same species via their mycorrhizal networks. The saplings with the greatest access to these networks were the healthiest (*Ecology*, vol 90, p 2808).

As well as sharing food, mycorrhizal associations may also allow plants to share information. Biologists have known for a while that plants can respond to airborne defence signals from others that are under attack. When a caterpillar starts to munch on a tomato plant, for example, the leaves produce noxious compounds that both repel the attacker and stimulate neighbouring plants to ready their own defences.

Yuan Yuan Song of South China Agricultural University in Guangzhou and colleagues investigated whether similar chemical alarm calls travel underground. They exposed one group of tomato plants to a pathogenic fungus and monitored the response in a second group connected to the first via a mycorrhizal network. The diseased plants were sealed inside airtight plastic bags to prevent any communication above ground. Nevertheless, the healthy partners began producing defence chemicals, suggesting that the plants detect each other's alarm calls via their mycorrhizal networks (*PLoS One*, vol 5, p e13324).

Another recent discovery, one which may be connected with Song's finding, is that some plants recognise members of their own species and apparently work together for the common good. Amanda Broz of Colorado State University in Fort Collins paired spotted knotweed plants inside a greenhouse either with other knotweeds or with blue bunchgrass. She then simulated an attack by spraying them with methyl jasmonate, a chemical many plants release when wounded. The knotweed's response depended on its neighbours. When growing near members of its own species, it produced leaf toxins to boost its defences. But it chose to focus on leaf and stem growth when its neighbours were bunchgrass (*BMC Plant Biology*, vol 10, p 115).

Such discrimination makes sense because, in the knotweed's native environment, dense clusters of a single plant tend to attract large numbers of insects to an all-you-can-eat buffet. So cooperating with other knotweed plants helps stave off an attack. However, when knotweed is surrounded by bunchgrass, a better strategy is to leave defence to its neighbours and concentrate on aggressive growth - which might also help explain why knotweed is such an effective invasive species.

Broz's research was published just last year, and it remains unclear how knotweed, or any other plant, could be recognising members of its own species. However, one instance of a plant with family values has been more thoroughly explored.

In a landmark paper published in 2007, Susan Dudley from McMaster University in Ontario, Canada, reported the first case of plants recognising and favouring their kin (*Biology Letters*, vol 3, p 435). Her studies of American sea rocket, a scraggly weed that grows along the shorelines of the Great Lakes, showed that a plant potted with an unrelated individual did not hesitate to spread its roots and soak up as much water and nutrients as it could. However, when Dudley planted sea-rocket siblings in the same pot, they exercised restraint, taming their eager roots to better share resources. Siblings and strangers that grew near each other but did not share pots showed no differences in root growth, indicating that sea rocket relies on underground chemical signalling to identify its kin. They don't seem to be using mycorrhizal networks, though.

In subsequent research with Meredith Biedrzycki from the University of Delaware in Newark, Dudley discovered that the signals take the form of "exudates" - a cocktail of soluble compounds including phenols, flavonoids, sugars, organic acids, amino acids and proteins, secreted by roots into the rhizosphere. How these indicate relatedness is still a mystery, though (*Communicative & Integrative Biology*, vol 3, p 28).

In the past few years, kin recognition has been discovered in other plants, including the botanical "lab rat" *Arabidopsis* and a kind of *Impatiens* called pale jewelweed. This has led some botanists to argue that plants, like animals, are capable of kin selection - behaviours and strategies that help relatives reproduce. Kin selection has an evolutionary rationale because it increases the chances that the genes an individual shares with its relatives will be passed to the next generation, even if altruistic behaviour comes at a cost to one's own well-being. "There's no reason to think plants wouldn't get the same benefits from kin selection that animals do," says Dudley.

Recognising siblings and restraining one's growth in response certainly looks like kin selection, but that still leaves the question of whether such interactions also improve the survival prospects of related plants. Research by Richard Karban at the University of California, Davis, goes some way to answering that. Karban studied a desert shrub called sagebrush, which emits a pungent bouquet of chemicals to deter insects. When he clipped an individual plant's leaves to simulate an attack, he found that it mounted a more robust defence if it was growing next to its own clone than if its neighbour was unrelated. What's more, for a period of five months afterwards, the neighbouring clones suffered far less damage from caterpillars, grasshoppers and deer than did unrelated neighbours (Ecology Letters, vol 12, p 502).

Studying kin selection and other plant interactions doesn't just improve our knowledge of basic plant biology and ecology. "There are a lot of people really interested in it, because it's not just an intellectually neat puzzle," says James Cahill at the University of Alberta in Edmonton, Canada. "There are many potential applications, especially for agriculture."

One obvious area is in companion planting - the strategic positioning of different crops or garden plants so they benefit one another by deterring pests, attracting pollinators and improving nutrient uptake. This ancient technique, which traditionally relies on trial and error and close observation, can be highly effective. For example, beans fix nitrogen that boosts growth in some other plants, and when Europeans arrived in America in the 15th century, they discovered that Native Americans used corn as a natural trellis for bean plants. Our modern understanding of plant interactions suggests we could find new, more subtle and potentially beneficial relationships, which could help us overcome a major drawback of modern monoculture farming. Since a single pathogen can wipe out an entire crop of genetically similar - and therefore equally vulnerable - plants, farmers make heavy use of pesticides. But instead of picturing an endless stretch of corn or wheat, imagine something more like a jungle of diverse species that work together above and below ground.

Breeding cooperation

Cahill has another idea. "Fertilisers aren't always spread evenly," he says. "Maybe we could breed plants to cooperate more effectively with their neighbours to share fertiliser." Meanwhile, Simard thinks the recent discoveries about mycorrhizal networks have implications for both agriculture and forestry. Hardy old trees should not be removed from forests so hastily, she says, because saplings depend on the mycorrhizal associations maintained by these grandparent trees. She also suggests that farmers should go easy on fertilisation and irrigation because these practices can damage or destroy delicate mycorrhizal networks.

Clearly, we do not yet have all the information we need to start deploying such tactics. "What we want to do next is develop more advanced techniques to watch roots grow, to really see what they do with each other and how they interact in space," Dudley says. She also wants to figure out what genetic factors control plant interactions and look at how they change survival and reproduction. "The molecular aspects are perhaps the most challenging," she adds, "but we have made some big leaps."

The idea that plants have complex relationships may require a shift in mindset. "For the longest time people thought that plants were just there," says Biedrzycki. "But they can defend themselves more than we thought and they can create the environment around them. It turns out they have some control over what is going on through this chemical communication." Passive and silent though plants may seem, their abilities to interact and communicate should not come as such a shock. "Some incredibly simple organisms - even one-celled organisms - can recognise and respond to each other," says Broz. "Why is it so bizarre to think that plants could have this same kind of ability?"

See gallery: "Plants that act like people"

Scent of a victim

Many of the social interactions of plants seem to involve a form of sharing or cooperation mediated by chemical signals. However, some chemical communication is far from benevolent, as research on a parasitic vine called dodder has found.

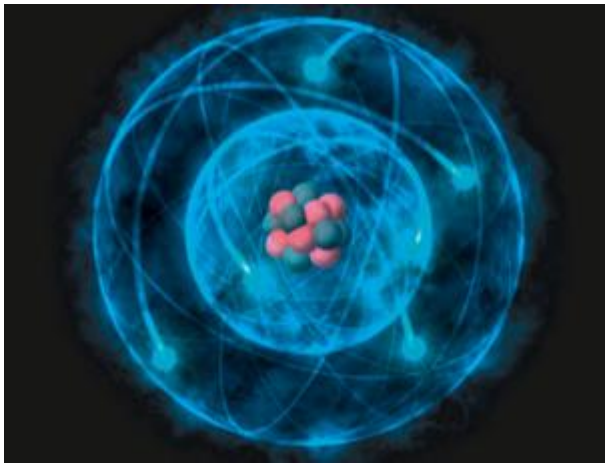
Dodder contains almost no chlorophyll - the green molecule that allows plants to produce sugars from sunlight, water and carbon dioxide. Instead, after sprouting as a leafless tendril, it searches for a victim into which it sinks its nozzles and sucks out the sugary sap. "We knew how it creates nozzles and gets resources from the host, but nobody knew how dodder found its host," says Consuelo De Moraes at Pennsylvania State University at University Park.

Some plants identify neighbours by sensing sunlight refracted off their leaves, but time-lapse video suggests that dodder uses a different technique. The footage shows that when the tendril searches for a host it twirls about like a snake tasting the air. Could it be searching for a chemical, wondered De Moraes?
To test this idea, she and her colleagues hid a variety of plants around a corner from a dodder tendril. If the vine were really using chemical sensing to find its victims, it should be able to home in on its hosts using the volatile chemicals they naturally produce.
That is exactly what they found. In fact, dodder even showed dietary preferences based on the different airborne chemicals, almost always choosing succulent tomatoes over twiggy wheat, and favouring healthy hosts by avoiding the chemicals given off by damaged plants (*Science*, vol 313, p 1964). "Not only does dodder use chemical cues to find a host," says De Moraes, "it can distinguish between hosts of different qualities. It knows which plants are healthier and goes after them."
Ferris Jabr *is a reporter with New Scientist in Boston*

http://www.newscientist.com/article/mg20928051.500-heard-it-on-the-grapevine-the-secret-society-of-plants.html?

Proton puzzle: Trouble at the heart of the atom

- 30 March 2011 by **Kate McAlpine**
- Magazine issue 2805.



Nuclear bad boys (Image: Dorling Kindersley/Getty)

Editorial: "In praise of the humble proton"

We used to think we understood protons, but these bedrocks of the atomic nucleus could send our theories of particle physics tumbling

IN THE long life of a proton, 10 years is a mere trice. These peerlessly stable particles, the bedrock of the atomic nucleus, are not prone to the decadence and decay of some of their subatomic brethren. Measuring their lifetimes means watching very many of them do very little for a very long time. Our current best estimate is that they survive for upwards of 10^{29} years - over a billion billion times the age of the universe. Ten years, though, is what it took for Randolph Pohl and his colleagues to show that the proton is not all it seems. The results of their experiments at the Paul Scherrer Institute (PSI) in Villigen, Switzerland, were published in July last year. The proton hadn't suddenly become less stable. But it was quite a bit smaller than theory or previous experiments allowed (*New Scientist*, 10 July 2010, p 10).

In the hyperaccurate world of subatomic physics, this was dynamite. A firestorm of claim and counter-claim followed. But with simpler explanations for the discrepancy now running out, it seems the mysterious shrinking of the proton has opened up a fundamental hole in our understanding of what makes atoms tick. What gives?

The doings of protons, as of all charged particles, are dealt with by a theory called quantum electrodynamics, or QED. One facet of nature it describes is the electromagnetic force, for example how the to-ing and fro-ing of photons of light keeps negatively charged electrons orbiting positively charged protons and so makes atoms possible. Deeper in the atomic nucleus lies the realm of a companion theory, quantum chromodynamics or QCD, which describes how protons and the like are themselves assemblages of smaller particles - quarks - and gluons that bind these quarks together. Together, QED and QCD are the two pillars of particle physicists' proudest accomplishment, their "standard model".

The inner life of protons is known to be murky and impenetrable (see "All in a spin"). Outwardly, though, all seems sweetness and light. Take the proton's radius, whose accepted value has been settled on using two different kinds of measurement. The first, direct approach is to shoot electrons in the general direction of protons, like firing rubber pellets at a fairground duck. By measuring at what point they start bouncing off, we can get an idea of where the electrons encounter the protons' fuzzy ball of charge.

Muon mischief

The second approach involves measuring the orbital energy levels of the electron circling the central proton of a standard hydrogen atom. The energy levels can be fed into QED calculations to determine how far the proton's ball of charge must extend to keep the electron in those orbits.

The results of these two approaches are in good agreement. Averaging them gives the proton a radius of 0.877 femtometres, or a fraction under a trillionth of a millimetre.

And so all was well, until Pohl and his colleagues set out in the late 1990s to determine the proton's radius using a third, supposedly more accurate method. They created hydrogen-like atoms in which the electrons were replaced by muons. These particles have the same negative charge as electrons but are some 200 times weightier. That means they orbit 200 times closer in than electrons, giving them an up-close-and-personal feel for how big the proton is.

Measuring the muons' orbital energy levels meant first guessing the gaps between the two levels of interest, so a laser could be tuned to the right frequency to bump a muon from one level to another. The team did this by reversing the QED equations and plugging in the accepted value for the proton's radius to give an estimated starting point.

In the first couple of attempts to run the full experiment, in 2003 and 2007, that approach didn't work: the muons did not respond. It was only in 2009, when the team had a new laser that could reach higher frequencies, that they found the muons' sweet spot and persuaded them to dance. Feeding the experimentally determined energy levels back into the QED calculation produced the shocker. The error on the proton's radius had shrunk by a factor of 10, as expected - but the radius had shrunk too. At 0.8418 femtometres, it was about 4 per cent lower than the previous average (*Nature*, vol 466, p 213).

Four per cent might not sound much, but in QED, where theory and experiment can agree to a part or two in a billion, it was a huge embarrassment. And there was no obvious flaw in the measurement. "We had to take the discrepancy seriously," says Michael Distler of the University of Mainz, Germany.

Just a few weeks later, Distler and his colleagues thickened the plot still more. They published a measurement of the proton radius using the tried and tested electron-scattering method that not only doubled its accuracy, but brought its value perfectly into line with that from measuring energy level shifts in regular hydrogen (*Physical Review Letters*, vol 105, p 242001). The muon experiment, which should have been the most accurate, was the odd one out. But why?

One early proposal was that the proton is surrounded by a large and diffuse halo of positive charge, meaning the distantly orbiting electron and the closer muon "see" protons of different sizes (*New Scientist*, 25 Sept 2010, p 16). That model seems to have been discounted, though, as it made other predictions at odds with the improved electron-scattering experiments. Now attention has shifted to more fundamental possible flaws: that we might have overlooked subtleties in the workings of QED, or that QED itself is missing something.

The first possibility stems from the fact that, according to QED, two charged particles orbiting each other will exchange photons. The stronger the bond between the particles, the more energy these photons will have. If the energy oversteps a certain mark, a photon can up the ante and briefly morph into a particle and its antiparticle - an electron and a positron, for example - before switching back to being a photon again.

Because a stronger bond is needed for a proton to rein in the more massive muon, there is more scope for this sort of thing in muonic hydrogen. The idea is that a thick cloud of ephemeral particles and antiparticles shields the orbiting muon from some of the attractive effect of the proton, reducing the proton's effective radius (see diagram).

It sounds plausible, but there's one problem: finding a particle-antiparticle pair that produces exactly the right amount of shielding. That would require the pair to have a combined mass of around 46 megaelectronvolts (MeV) - far more than an electron-positron pair, which weighs in at just over 1 MeV, but far below the more than 200 MeV needed for a muon-antimuon pair.

For Ulrich Jentschura, a physicist at the Missouri University of Science and Technology in Rolla, that makes things tricky. "Theory has a problem even inventing a particle that could explain the discrepancy without messing something else up," he says. He and others have been analysing the possibility that a new particle from a "hidden sector" of the standard model might be rearing its head. So far, though, they have found nothing that would not also upset established experimental results in normal hydrogen (*Physical Review D*, vol 82, p 125020; *Annals of Physics*, vol 326, p 516).

One proposal from the Mainz group is that the culprit is a fleet-footed pairing of a quark and an antiquark. That's controversial. Quarks and their antiparticles are only known to bind together inside particles such as the proton, where they are weighed down with a lot of gluon baggage. The lightest known quark-antiquark pairing, the pion, tips the scales at 140 MeV. The researchers think that bound quark-antiquark pairs might

appear and disappear so quickly that they never pick up the full gluon burden (*Physics Letters B*, vol 696, p 343). In that case, they could be lighter.

Not everyone is convinced. Krzysztof Pachucki of the University of Warsaw in Poland agrees that QED might link up with the QCD of quarks and gluons to produce unforeseen or underestimated interactions - but points out that, again, we would expect to see the effects in other experiments.

That leaves the possibility that there is a blemish on QED itself. Few physicists think that likely, given the theory's superlative accuracy in almost all its predictions. Even so, theorists have been combing the relevant equations for a sign of something missing. "Up to now, nothing large enough to explain a 4 per cent difference seems to show up," says Paul Indelicato, a theorist at the Kastler Brossel Laboratory in Paris, France, who was part of the PSI muonic hydrogen team.

Moustachioed Mona Lisa

Alexander Kholmetskii of the Belarusian State University in Minsk and his colleagues think they have something. The problem lies, they claim, with the equation - the Dirac equation - that was the foundation stone for QED and is used to describe the energy states of particles such as an orbiting electron or muon in an atom. There are two components to this equation, one describing how the particle ties up energy by binding itself to the nucleus with photons, and one describing how it can lose energy by radiating away photons.

In the lowest-energy orbital state, the researchers argue, this kind of radiative loss is not possible, and so they apply a small correction. Feeding this into the calculations of the proton radius leaves the value measured using muons virtually unchanged, while moving the electron result into almost perfect agreement with it (arxiv.org/abs/1010.2845) Exactly the same correction solves a similar energy-level problem in positronium, an "atom" in which an electron and a positron orbit each other.

It's this explanation, though, that has raised the most hackles. The Dirac equation is widely feted as one of the most beautiful, concise equations in all of physics. Bolting corrections onto it is, to many physicists, akin to scrawling a moustache on the Mona Lisa. "There is no need to invoke whatever they do to explain radiative properties of atoms," says Indelicato. The fact that the lowest energy level can't give up energy is already built into QED, he says.

All that leaves us at an impasse, with no explanation gaining universal approval. "There are papers which claim to explain, but they are wrong," says Pachucki.

With theory at a deadlock, attention is now turning to another round of experiments. We have measured the proton's radius by shooting electrons at it, and by measuring the energy levels of electrons and muons orbiting it. Might shooting muons at it bring some new insight? If these muon missiles see a differently sized proton, then there must be something fundamentally different in the way muons interact, such as the involvement of new particles or particle pairings we hadn't thought of. And if they don't, says Jentschura, then we're really stuck. "Then the current discrepancy would seem all the more intriguing and strange," he says.

Meanwhile Pohl, Indelicato and their colleagues are starting to make measurements on muonic deuterium. This exotic atom's nucleus, consisting of a proton and a neutron, can also be used to calculate the proton's radius. Perhaps another decade might bring us a definitive answer.

All in a spin

While the debate about the proton's size has only just blown up (see main story), the particle's innards have been puzzling us for rather longer - specifically since 1988, when researchers at CERN near Geneva, Switzerland, discovered they could not account for the proton's spin.

Spin is a quantum-mechanical property of a particle akin to a rotation about its own axis. Particles of different spins respond to magnetic fields in different ways, so it is a relatively easy thing to measure. The proton, for example, has a spin of ½.

This spin must in some way come from the spin of the proton's components, just as the proton's one unit of positive charge comes from totting up the charge of the three "valence" quarks within it, two of charge +2/3 and one of charge -1/3.

By shooting protons apart with high-energy muons, CERN's European Muon Collaboration managed to measure the spin of the proton's interior quarks. They found it could account for only something like one-quarter of the expected spin (*Physics Letters B*, vol 206, p 364). Subsequent experiments have upped that proportion a little, but confirmed the basic result.

This "spin crisis" has been the source of much head-scratching since. "We thought we understood the quantum structure of the proton, but at its heart we don't," says Robert Jaffe, a theorist at the Massachusetts Institute of Technology.

Ideally, we would solve the crisis by solving the equations of quantum chromodynamics (QCD), the theory that governs interactions within the proton. But these turn out to be monstrously difficult for a particle with as many moving parts as the proton - not just the valence quarks, but the gluons that bind them and a "sea" of other ephemeral quarks and gluons that according to the inconsequential rules of quantum physics briefly pop up out of nowhere and disappear again. Such complications also overwhelm attempts to use supercomputers to simulate the origin of the proton's spin.

So we are left with messy experiments to fill in the gaps. One suggestion is that gluons might themselves carry a substantial proportion of the proton's spin. Measuring that directly is tricky, but experiments going on at CERN and elsewhere indicate contributions close to zero.

Then there is the possibility that the proton's spin might have less to do with how quarks and gluons spin individually and more to do with how they orbit each other. As yet we have only the vaguest of ideas how we might go about measuring that.

The result is a stalemate. "We're basically waiting for some bright young person to come up with some bright idea," says Jaffe.

Why do we care? First, says Jaffe, because we are all made up of protons and neutrons and we'd like to know how we work. For physicists, though, there is even more at stake. If there is such a thing as a theory of everything, we expect it will look a lot like QCD, only harder. If we can't understand what goes on within the humble proton, hopes will fade that we will ever be able to get to grips with that greater theory. **Richard Webb**

Kate McAlpine *is a freelance writer based in London*

http://www.newscientist.com/article/mg20928051.600-proton-puzzle-trouble-at-the-heart-of-the-atom.html?

Wind and wave farms could affect Earth's energy balance

- 30 March 2011 by **Mark Buchanan**
- Magazine issue 2806.

Engines of fantasy (Image: KeystoneUSA-ZUMA/Rex Features)

UPDATE, April 6: *This article has elicited a considerable amount of interest, and some criticism. We always welcome discussions of the stories we publish. Some readers felt the original headline (Wind and wave energies are not renewable after all) was misleading, so to address these concerns we have changed it. We have also been made aware of a wider debate about Kleidon's research that we did not address in the original article: we will continue to follow this issue and report back on what we find.*

Editorial: "The sun is our only truly renewable energy source"

The idea that we can draw endless supplies of clean energy from the wind and waves just doesn't add up

WITNESS a howling gale or an ocean storm, and it's hard to believe that humans could make a dent in the awesome natural forces that created them. Yet that is the provocative suggestion of one physicist who has done the sums.

He concludes that it is a mistake to assume that energy sources like wind and waves are truly renewable. Build enough wind farms to replace fossil fuels, he says, and we could seriously deplete the energy available in the atmosphere, with consequences as dire as severe climate change.

Axel Kleidon of the Max Planck Institute for Biogeochemistry in Jena, Germany, says that efforts to satisfy a large proportion of our energy needs from the wind and waves will sap a significant proportion of the usable energy available from the sun. In effect, he says, we will be depleting green energy sources. His logic rests on the laws of thermodynamics, which point inescapably to the fact that only a fraction of the solar energy reaching Earth can be exploited to generate energy we can use.

When energy from the sun reaches our atmosphere, some of it drives the winds and ocean currents, and evaporates water from the ground, raising it high into the air. Much of the rest is dissipated as heat, which we cannot harness.

At present, humans use only about 1 part in 10,000 of the total energy that comes to Earth from the sun. But this ratio is misleading, Kleidon says. Instead, we should be looking at how much useful energy - called "free" energy in the parlance of thermodynamics - is available from the global system, and our impact on that.

Humans currently use energy at the rate of 47 terawatts (TW) or trillions of watts, mostly by burning fossil fuels and harvesting farmed plants, Kleidon calculates in a paper to be published in *Philosophical Transactions of the Royal Society*. This corresponds to roughly 5 to 10 per cent of the free energy generated by the global system.

"It's hard to put a precise number on the fraction," he says, "but we certainly use more of the free energy than [is used by] all geological processes." In other words, we have a greater effect on Earth's energy balance than all the earthquakes, volcanoes and tectonic plate movements put together.

Radical as his thesis sounds, it is being taken seriously. "Kleidon is at the forefront of a new wave of research, and the potential prize is huge," says Peter Cox, who studies climate system dynamics at the University of Exeter, UK. "A theory of the thermodynamics of the Earth system could help us understand the constraints on humankind's sustainable use of resources." Indeed, Kleidon's calculations have profound implications for attempts to transform our energy supply.

Of the 47 TW of energy that we use, about 17 TW comes from burning fossil fuels. So to replace this, we would need to build enough sustainable energy installations to generate at least 17 TW. And because no technology can ever be perfectly efficient, some of the free energy harnessed by wind and wave generators will be lost as heat. So by setting up wind and wave farms, we convert part of the sun's useful energy into unusable heat.

"Large-scale exploitation of wind energy will inevitably leave an imprint in the atmosphere," says Kleidon. "Because we use so much free energy, and more every year, we'll deplete the reservoir of energy." He says this would probably show up first in wind farms themselves, where the gains expected from massive facilities just won't pan out as the energy of the Earth system is depleted.

Using a model of global circulation, Kleidon found that the amount of energy which we can expect to harness from the wind is reduced by a factor of 100 if you take into account the depletion of free energy by wind farms. It remains theoretically possible to extract up to 70 TW globally, but doing so would have serious consequences.

Although the winds will not die, sucking that much energy out of the atmosphere in Kleidon's model changed precipitation, turbulence and the amount of solar radiation reaching the Earth's surface. The magnitude of the changes was comparable to the changes to the climate caused by doubling atmospheric concentrations of carbon dioxide (*Earth System Dynamics*, DOI: 10.5194/esd-2-1-2011).

"This is an intriguing point of view and potentially very important," says meteorologist Maarten Ambaum of the University of Reading, UK. "Human consumption of energy is substantial when compared to free energy production in the Earth system. If we don't think in terms of free energy, we may be a bit misled by the potential for using natural energy resources."

This by no means spells the end for renewable energy, however. Photosynthesis also generates free energy, but without producing waste heat. Increasing the fraction of the Earth covered by light-harvesting vegetation - for example, through projects aimed at "greening the deserts" - would mean more free energy would get stored. Photovoltaic solar cells can also increase the amount of free energy gathered from incoming radiation, though there are still major obstacles to doing this sustainably (see "Is solar electricity the answer?").

In any event, says Kleidon, we are going to need to think about these fundamental principles much more clearly than we have in the past. "We have a hard time convincing engineers working on wind power that the ultimate limitation isn't how efficient an engine or wind farm is, but how much useful energy nature can generate." As Kleidon sees it, the idea that we can harvest unlimited amounts of renewable energy from our environment is as much of a fantasy as a perpetual motion machine.

Is solar electricity the answer?

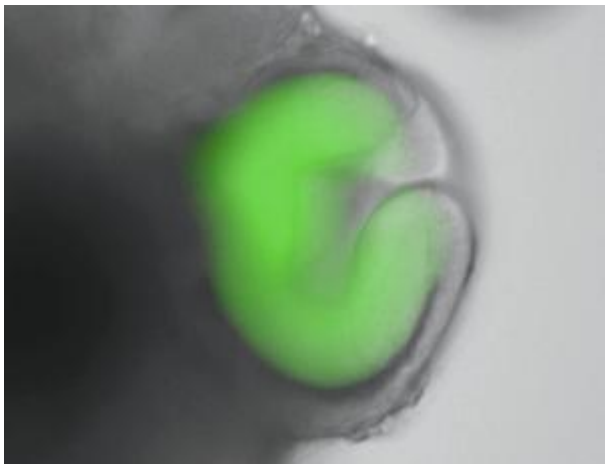
A solar energy industry large enough to make a real impact will require cheap and efficient solar cells. Unfortunately, many of the most efficient of today's thin-film solar cells require rare elements such as indium and tellurium, whose global supplies could be depleted within decades.

For photovoltaic technology to be sustainable, it will have to be based on cheaper and more readily available materials such as zinc and copper, says Kasturi Chopra of the Indian Institute of Technology, New Delhi. Researchers at IBM showed last year that they could produce solar cells from these elements along with tin, sulphur and the relatively rare element selenium. These "kesterite" cells already have an efficiency comparable with commercially competitive cells, and it may one day be possible to do without the selenium. Even if solar cells like this are eventually built and put to work, they will still contribute to global warming. That is because they convert only a small fraction of the light that hits them, and absorb most of the rest, converting it to heat that spills into the environment. Sustainable solar energy may therefore require cells that reflect the light they cannot use.

http://www.newscientist.com/article/mg21028063.300-wind-and-wave-farms-could-affect-earths-energy-balance.html?

Stem cells coaxed into forming partial eyeball

- 18:00 06 April 2011 by **Helen Thomson**



The self-organised optic cup: the retinal tissue is shown in green (Image: M. Eiraku and Y.Sasai at RIKEN Center for Developmental Biology)

Mouse stem cells have been coaxed into forming a partial eyeball, and the method may one day lead to retina transplants.

Yoshiki Sasai at the RIKEN Center for Developmental Biology in Kobe, Japan, and colleagues encouraged embryonic stem cells to develop into retinal cells, and then grew them alongside a protein matrix to promote the formation of tissue.

Over 12 days, the retinal cells formed a vesicle which subsequently transformed into a cup-like structure. Within this "optic cup", six major types of retinal cells were identified. They had spontaneously arranged themselves into six different layers, mimicking those seen in the adult retina.

While it is not yet possible to generate a fully formed eye – including a lens, sclera and cornea – Sasai says it may be feasible to use human stem cells with minor modifications to generate retinal tissues large enough for human transplantation in the next few years.

"The retina is severely impaired in genetic diseases such as retinitis pigmentosa. This replacement therapy would become practical once human retina tissue is available by our method," says Sasai.

Journal reference: *Nature*, DOI: 10.1038/nature09941

http://www.newscientist.com/article/dn20341-stem-cells-coaxed-into-forming-partial-eyeball.html

Superbug spreads in Delhi sewers

- 14:55 07 April 2011 by **Debora MacKenzie**

A gene that makes bacteria invulnerable to many antibiotics, including drugs of last resort, has just got a lot scarier. It was thought to pose a threat mainly in hospitals, but it has now been found in sewers and drinking water in India's capital, New Delhi.

And it is likely to be much more widespread than that. The gene has already invaded germs that cause cholera, dysentery and other major infections, and can jump readily among bacteria in the conditions of India's monsoon season.

Surveys are desperately needed to find out where it has gone and what bacteria carry it, say researchers. But political backlash in India has made it hard for scientists based in the country to do so – for instance, the water samples for the current study were collected by a journalist for the British TV programme *Channel 4 News*, not academic researchers.

The *NDM-1* gene codes for an enzyme that destroys all but one antibiotic in a class called beta-lactams. These include the carbapenems, some of which still work against other antibiotic-resistant bacteria and are therefore used as last-ditch treatments – but they won't work against *NDM-1*.

The gene was discovered in 2009 at the University of Cardiff, UK, in a Swede who had had medical treatment in India. Last August the same team found it in 37 more people in the UK who had had surgery in India, Pakistan or Bangladesh.

Medical tourism

Antibiotic-resistant bacteria tend to emerge in hospitals, where the drugs are heavily used, so the discovery was widely reported as a threat to western "medical tourists" who get healthcare in India. Now, however, the Cardiff team reports that *NDM-1* is in bacteria from 2 per cent of tap water samples and 30 per cent of street puddles from across New Delhi. Because DNA in the samples had degraded, the researchers say the true prevalence is probably much higher.

It is also unlikely to be in New Delhi alone. "We know it is in patients in Mumbai and Chennai, and I have good information that it is in Calcutta," says Tim Walsh of the Cardiff team, now at the University of Queensland in Brisbane, Australia. People in Pakistan and Bangladesh also had bacteria with the gene, he says. "It is probably widespread in the environment across south Asia."

"If a woman gets a urinary tract infection with *NDM-1*, it is untreatable," he says, because the only two antibiotics that defeat *NDM-1* don't affect the urinary tract. GlaxoSmithKline has a drug that defeats *NDM-1* in development but it won't be ready for several years, "and in several years we'll need 10 drugs that work against it, not one", adds Walsh.

Escape route

Similar antibiotic-resistance genes mostly stay in hospitals, says Mark Toleman at the University of Cardiff. But *NDM-1* escaped on a plasmid – a small mobile chunk of DNA – carried by the common gut bacterium *Escherichia coli*, which is shed in faeces.

The plasmid also carries a toxin that forces bacteria to acquire it, plus several other antibiotic-resistance genes. The team found that a wide range of bacteria, including important human pathogens such as cholera and *Shigella*, readily pick up the plasmid at 30 ºC, a common temperature during the Indian monsoon season. To make matters worse, sewers also flood during the monsoon.

Clean water and sanitation would help to limit human exposure to the bacteria, say Walsh and Toleman. Research to track where the gene has gone would also help. But there was a political uproar in India after the team's August paper, because reports of *NDM-1* were said to threaten the medical tourism industry. "The Indian scientists who worked with us on our last paper were told bluntly not to work on *NDM-1* again," says Walsh.

Mohammed Shahid of Aligarh Muslim University, India, is looking for *NDM-1* in faecal and environmental samples nevertheless. "The situation is not miserable," he says, but the threat of international spread of the plasmid "is real and should not be ignored".

Journal reference: *The Lancet Infectious Diseases*, DOI: 10.1016/s1473-3099(11)70059-7

http://www.newscientist.com/article/dn20352-superbug-spreads-in-delhi-sewers.html

Brain scans suggest psychopaths could be treated

- 06 April 2011 by **Jessica Hamzelou**
- Magazine issue 2807

Time to change tack? (Image: Ann Johansson/Corbis)

Psychopaths are typically considered untreatable, but brain scans could change that

DANGEROUS, manipulative and, above all, untreatable. The traditional picture of the psychopath is one that everyone, from psychiatrists to members of a jury, seems to share.

But although this picture encourages a "lock them up and throw away the key" mentality, surprisingly little is really known about how, or if, rehabilitation is possible for psychopaths. Now, brain scans of children with psychopathy-like conditions suggests objective ways to diagnose psychopathy, new targets for therapy - and techniques for settling the question of whether or not psychopaths can be successfully treated and released.

For 15 years, psychiatrists have relied on the Hare psychopathy checklist to diagnose the condition. The revised version - the PCL-R - consists of a formal interview and an analysis of an individual's past behaviour, which is scored for indicators including superficial charm, pathological lying, a grandiose sense of self-worth, and a lack of guilt or empathy. The PCL-R is generally accepted as the best available way to diagnose psychopathy, but such interview-based methods are vulnerable to subjective scoring, and clever individuals can learn how to pass them.

"Psychopaths by their nature are deceitful and cunning, so they can pick up on what authorities want to hear," says Michael Koenigs, a neuroscientist at the University of Wisconsin, Madison.

Looking for the signs of psychopathy in brain scans could sidestep such problems, but with every new glimpse into the psychopathic brain, the picture seems to become more confused.

For instance, initial studies of brain activity as psychopaths were presented with photographs of negative emotional scenes showed abnormally high activity in the cerebellum, fusiform gyrus and postcentral gyrus, suggesting these brain regions are involved in the condition. But a repeat run of the experiment in different psychopaths revealed different foci of abnormal activity: the medial temporal lobe, and occipital and parietal cortices (*Molecular Psychiatry*, DOI: 10.1038/mp.2010.124).

Such results suggest that identifying psychopaths through brain scans is no easy task, says Marcus Raichle at Washington University in St Louis, Missouri. He thinks the task is made more difficult because "their brains are likely to show signs of drug or alcohol abuse and violence-related head injuries".

The study of children with psychopathic traits could help. So-called callous unemotional traits are considered symptoms of psychopathy in children, and some, though not all, go on to be diagnosed with psychopathy as adults. The condition is thought to be genetic in around half of them. These youngsters may already have embarked on a similar lifestyle to adult psychopaths, but their brains have had less time to pick up the signatures associated with this damage, so pinpointing the brain behaviour relating directly to the condition may be easier.

Two recent studies point the way. Graeme Fairchild and his colleagues at Southampton University in the UK studied MRI brain scans of 65 adolescent boys diagnosed with conduct disorder - a category of personality disorder that includes callous unemotional traits. They compared these with 27 scans of healthy adolescents of the same age and IQ and found that regions of the brain involved in emotion and empathy were smaller than average in the boys with conduct disorder.

However, a different picture emerged when Fairchild's team focused on the adolescents with conduct disorder who also showed callous unemotional traits. Brain areas involved in reward processing, including the striatum and caudate nucleus, were larger than normal, whereas they were smaller than normal in those with conduct disorder only (*American Journal of Psychiatry*, DOI: 10.1176/appi.ajp.2010.10081184). The finding might explain why callous unemotional adolescents seek instant gratification, says Fairchild.

Raichle and his colleagues are also studying the adolescent brain, and in particular the structure of white matter - the tracts that make up the brain's connections. They scanned the brains of 107 incarcerated teens and found that, for those who showed impulsive behaviour, rising levels of activity in the motor cortex - a region responsible for planning voluntary actions - were matched by rises in brain regions responsible for introspection. In contrast, there was a fall in introspection in non-impulsive teens when they planned actions, but a rise in the activity of regions involved in attention and control.

This suggests that impulsivity - a key marker of psychopathy-like traits in adolescents - is linked to abnormal connections between these regions of the brain, says Raichle, who presented the findings at the Latin American School for Education Cognitive and Neural Sciences in San Pedro de Atacama, Chile, last month.

The two studies provide the best evidence yet that there are structural abnormalities in the brains of children with callous unemotional traits, says Koenigs. They also offer researchers new targets for attempts to reverse the condition - and perhaps also for reversing the symptoms of psychopathy. For instance, the link between psychopathic-like traits and enlarged reward-processing areas suggests "we may need to focus therapies on rewards rather than punishments", Fairchild says. Raichle, meanwhile, thinks his work suggests that psychopaths could be helped through training to better control their actions.

More importantly, the studies suggest there may be better ways to judge the success of any therapy. Questionnaire-based methods rely on psychopaths giving honest answers. A brain-scan approach gets around this obstacle and means the notion that psychopaths are untreatable can now be put to the test.

Kent Kiehl at the University of New Mexico in Albuquerque is using a mobile MRI scanner to study the brains of psychopathic inmates in prisons across New Mexico as they undergo a standard rehabilitation programme. "I believe we will see reorganisation of tissues, and that reorganisation might be able to predict who is likely to reoffend," he says. "Theoretically, I think it's possible that we can figure out whether treatment has been successful or not."

The ability to be moral

"Language and general intelligence are intact in psychopaths, so they can recite social norms and legal rules," says Michael Koenigs of the University of Wisconsin, Madison. But are they able to make moral decisions? To find out, Koenigs and his colleagues have used hypothetical situations. "For example, you're in a shipwreck and end up in a lifeboat that's overcapacity," says Koenigs. "You would need to throw a number of people overboard to save the rest. Could you do it?" Most people find it very difficult to answer this question, but psychopaths appear to make simple mathematical calculations. This suggests these individuals can't tell the difference between what is morally right and wrong.

However, Maaike Cima's team at Tilburg University in the Netherlands has seen different results. When they compared psychopaths' and healthy individuals' responses to moral dilemmas, they found that both made similar judgements (*Social Cognitive and Affective Neuroscience*, DOI: 10.1093/scan/nsp051).

The debate could raise issues of culpability in the courts. "If psychopaths are lacking that moral response, you could argue that their ability to control their behaviour is compromised," says Koenigs. "It could affect whether the sentence is punitive or a mental health issue."

Kent Kiehl, also at the University of New Mexico, thinks evidence of moral reasoning abilities could offer hope for treating psychopaths. "They have the capacity to make reasonable decisions," Kiehl says. "It's now a case of getting them to do that in the real world."

http://www.newscientist.com/article/mg21028073.200-brain-scans-suggest-psychopaths-could-be-treated.html

Ear implants for the deaf with no strings attached

- 04 April 2011 by **Duncan Graham-Rowe**
- Magazine issue 2806

Soon they'll be invisible (Image: George Steinmetz/Corbis)

COCHLEAR implants have helped thousands of deaf people around the world hear for the first time. Now a tiny microphone implanted in a person's ear will provide them with continuous hearing day and night.

Existing implants can't be worn all the time because only a small part of the device is actually inside the cochlea. A fragile external unit containing the power supply, processors and microphone has to be hooked onto the ear and linked magnetically to the implant beneath the skin.

"Patients can't normally wear them in their sleep, in the shower, the rain or when they swim," says Herman Jenkins, chair of otolaryngology at the University of Colorado in Aurora. "A fully implanted system would get rid of all that because you could wear it round the clock," Jenkins says. But developing an internal microphone for such a system is quite a challenge.

Four years ago Cochlear, a firm based in Sydney, Australia, ran trials of a prototype implant in three patients, with mixed results, says Jan Janssen, head of Cochlear's design and development.

"People clearly appreciated the ability to hear 24/7," he says. But because the microphone was actually inside the ear it would pick up not just external sounds but also a wide range of bodily noises, including the sound of eating, swallowing, the rustling of hair and the beating of the heart.

So Cochlear turned to Otologics, a company in Boulder, Colorado, that was developing a fully implantable hearing aid with a new microphone that incorporates two sensors.

One is designed to capture all sounds while the other is tuned to pick up only internal noises. By comparing the two signals software can remove the unwanted bodily noises, says Jose Bedoya, the company's founder.

But it's not just a question of subtracting one set of sounds from the other, he says. "The relationship is extremely sensitive and has to be adjusted on a continuous basis," Bedoya says, because the sound levels constantly change. Another major difference is the size. The mic's diaphragm is larger than normal, improving the quality of the external signal to stop the sounds appearing muted.

So far four people have had the internal microphone implanted and hooked up to their normal cochlear implant, with two more trials to follow later this year, says Jenkins, who has been assessing the devices.

Cochlear is now licensing Otologics's technology and hopes to have a complete system working within five years.

Jenkins will be presenting preliminary findings at the American Otolaryngology Society meeting in Chicago later this month. The results look promising. In tests patients are hearing about 80 per cent of what an external microphone would provide, he says.

However, having a fully implantable hearing aid will increase the need for surgery, says Jenkins. The device's rechargeable batteries only have a finite lifespan.

This means you would require a new implant at least every 10 years, instead of having one device implanted for life, says Janssen. While surgery carries a risk of infection and nerve damage to the cochlea, experience has shown that these risks are very low, says Janssen. Ray Glover, of the National Cochlear Implant User's Association in Amersham, UK, agrees and says patients would rather have devices replaced more frequently if it means access to more up-to-date technology. "My son has vvhad his implant for 17 years," he says.

Bionic ear restores hearing

Perhaps the most successful bionic device ever, cochlear implants are designed to restore hearing in chronically deaf people. They differ from hearing aids in that they don't acoustically amplify sound. Instead, they translate sound into electrical signals that are used to electrically stimulate the cochlea - a spiral-shaped part of the inner ear attached to the auditory nerve. Normally, cochlear implants receive their signal and power through an induction loop linking the implant in the cochlea to an external unit containing the microphone and battery. A fully implanted device would still need an induction coil, but this would only be used for a few hours every couple of days to top up the batteries.

http://www.newscientist.com/article/mg21028064.800-ear-implants-for-the-deaf-with-no-strings-attached.html

Cannabis-like drugs could kill pain without the high

- 18:00 03 April 2011 by **Andy Coghlan**

Not all users want to get high (Image: Aaron McCoy/Getty)

An ingenious set of experiments has teased apart the mind-altering and pain-relieving effects of the main component of cannabis. This could open the way to cannabis-like drugs that provide pain relief without causing unwanted highs.

Cannabis is taken as a painkiller – to dull pain in cancer for example – but it can produce unpleasant side effects such as hallucinations and impaired mobility.

Now, a team led by Li Zhang of the US National Institute on Alcohol Abuse and Alcoholism in Bethesda, Maryland, has shown that tetrahydrocannabinol (THC) – the active component in cannabis that makes people high but that is also thought to dull pain – binds to different molecular targets on cells to produce these two effects.

It has long been known that THC gives people a high by binding to a molecular anchor on cells called the cannabinoid type-1 (CB1) receptor. Zhang and his team discovered that THC relieves pain by binding instead to receptors for the brain-signalling compound glycine and increasing their activity.

Through experiments on mice, they then confirmed that if the glycine receptor is absent or if its activity is blocked by another drug, the animals experienced pain in a standard "tail-flick" test even when given THC, confirming that the drug's pain-relief and psychotropic effects can be decoupled.

Target receptor

"We found that this glycine receptor could be a primary target for developing non-psychoactive forms of cannabis," says Lhang.

"This is an important breakthrough in the long-sought separation of intoxicant effects of THC from its desired medical effects," says Les Iversen at the University of Oxford in the UK, who studies the effects of marijuana.

However, Stephen Wright, director of research and development for GW Pharmaceuticals in Porton Down, UK, thinks that there are other ways that cannabis-based medicines may be able to provide pain relief without the side effects. Last year the firm launched a cannabis-based medicine in Europe called Sativex to dampen painful muscle spasms in patients with multiple sclerosis.

Wright says that no persistent psychotic effects have been seen with the product, partly because it is released into the body 20 to 40 times more slowly than THC is released when cannabis is smoked. As well as THC, GW's preparation contains cannabidiol, a component of marijuana thought to dampen psychotic reactions to THC.

No psychotic effects been seen in the US, where Sativex is being trialled to combat pain in cancer patients.

Journal reference: *Nature Chemical Biology*, DOI: 10.1038/nchembio.552

http://www.newscientist.com/article/dn20327-cannabislike-drugs-could-kill-pain-without-the-high.html

China tries again to stop smoking

- 01 April 2011
- Magazine issue 2806.

You can't light up here (Image: Jeff Hutchens/Getty)

CHINA, the world's largest consumer of cigarettes, is having another crack at kicking the habit. The Chinese government has announced it will ban smoking in enclosed public venues from May.

Businesses will have to put no-smoking signs on prominent display and carry out promotional activities warning people of the dangers of smoking.

It's a promising move, says Simon Chapman at the University of Sydney, Australia. He says experience in Australia, Canada and throughout Europe suggests an indoor ban on smoking reduces daily tobacco consumption by 20 per cent. "While people might smoke a little more before or after work, this does not make up for the smoking opportunities lost during their working day."

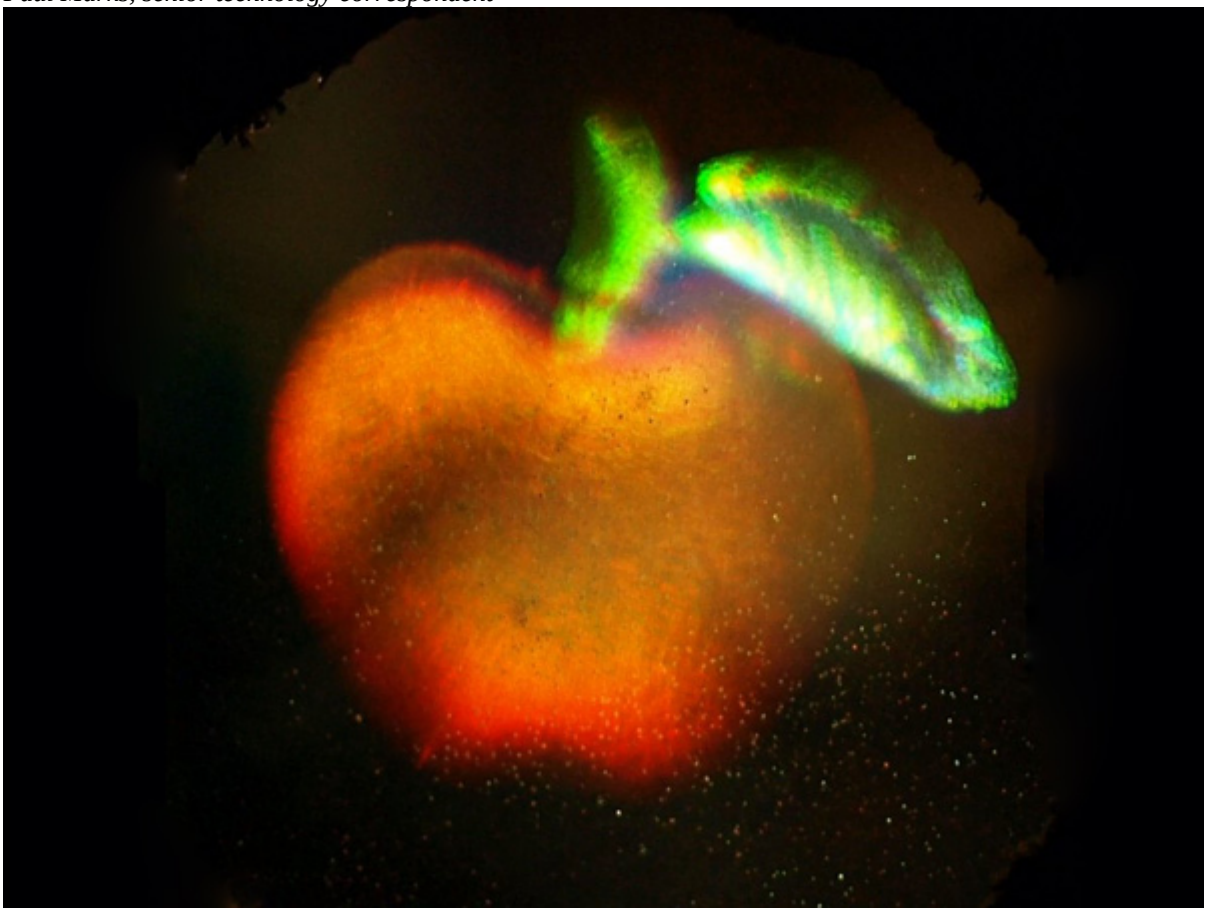
But China's past record on anti-smoking measures is patchy at best. In January it missed a deadline to restrict indoor smoking. And a survey of over 12,000 Chinese citizens published last year found that 41.1 per cent of smokers admitted to lighting up at work despite smoke-free policies (*Tobacco Control*, DOI: 10.1136/tc.2009.034207).

Chapman says raising the price of cigarettes would be a better strategy. Despite government plans to increase tobacco taxes, Chinese cigarettes remain among the cheapest in the world.

http://www.newscientist.com/article/mg21028063.100-china-tries-again-to-stop-smoking.html

Quantum effect fuels colour-fast holograms
19:20 7 April 2011

Paul Marks, senior technology correspondent



(Image: Science/AAAS)
With glasses-free 3D video displays appearing in gadgets like the astonishing Nintendo 3DS, and with research into video holograms continuing apace, you could be forgiven for thinking the field of still image holograms is utterly moribund. But not a bit of it.
If you can find ways to improve still holograms, says Satoshi Kawata of the RIKEN Institute in Wako, in Japan's Saitama prefecture, you can come up with innovations that feed into better video holograms and 3D displays.
And this week, his research team reports the successful development of a still image hologram with a colourful property - achieved through the novel use of quantum effect.
The RIKEN team have altered the way a hologram is recorded and displayed to ensure that the colour of the image remains the same at all angles.

A conventional hologram is effectively an interference pattern recorded on a photographic plate when laser light bounces off an object of interest. Re-illuminating the plate causes interference that reconstructs wavefronts that appear to have scattered off the object - so it looks 3D. But its colour depends on its viewing angle.
To overcome this, Kawata, Miyu Ozaki and Jun-ichi Kato harnessed a quantum surface effect. Metal films contain free electrons that oscillate on the surface and interact with incoming photons. Called a surface

plasmon polariton, this surface wave is confined within a light wavelength of the surface and can be harnessed to cause interference effects. By recording their holograms on 55-nanometre-thick metal films with red, green and blue lasers, they can ensure that the 3D image anybody sees is always the same colour - from any angle.

"Currently 3D TV receivers, 3D games machines and 3D movie theatre screens create an illusion using left and right eye images reconstructed by the brain," says Kawata. "We are creating an optical field in 3D from the actual object in natural colour - there is no illusion."

He hopes their technique will feed into research on new ways to make glasses-free 3D moving picture screens, as well as making holograms look more realistic.

Journal reference: *Science*, doi: 10.1126/science.1201045

http://www.newscientist.com/blogs/onepercent/2011/04/quantum-effect-fuels-colour-fa.html

Garbage-sorting robot gets its hands dirty

- 06 April 2011 by **Zena Iovino**
- Magazine issue 2806.

A ROBOT that automatically categorises waste from construction and demolition projects could enable valuable raw materials to be recycled instead of ending up in landfill.
Industrial robots normally excel at precise tasks in controlled environments, such as assembling cars. More chaotic and hazardous tasks have fallen to humans - for example, sorting through piles of waste in search of precious raw materials that could be recycled. But perhaps not for much longer.
Led by Tuomas J. Lukka, a team of researchers at ZenRobotics in Helsinki, Finland, are hoping robots can take over waste recycling.
The company's Recycler robot uses data from a combination of visual sensors, metal detectors, weight measurements and tactile feedback from a robotic arm to pick out likely pieces of refuse and categorise them. Through trial and error its machine learning software has been taught to recognise around a dozen types of material, including different plastics. And it can pluck out concrete, metal and wood from a stream of waste as it moves along a conveyor belt.
"I've never heard of anyone actually trying to do this in such an unstructured environment," says Edwin Olson, a computer scientist at the University of Michigan in Ann Arbor.
For more ambiguous types of waste, such as a piece of plywood with nails driven through it, the robot uses a spectrometer to recognise objects based on the unique patterns of light they reflect. This means the robot can distinguish the type of waste based on its colour and drop it into the appropriate bin.
Since the launch of the test phase in February, the robot has learned to correctly identify half of the construction debris it is fed.
That's far from perfect. But in the US, construction waste accounts for 50 per cent of all landfill material, according to the Construction Materials Recycling Association. Recycling just a fraction of that would mean big savings in resources, as well as landfill fees.
Though engineered for construction waste, the robot could one day sort household waste as well, says Lukka.

http://www.newscientist.com/article/mg21028065.000-garbagesorting-robot-gets-its-hands-dirty.html

Engraved plastic panels cast image in light and shade

- 05 April 2011 by **Jacob Aron**
- Magazine issue 2806.

Through a glass brightly (Image: Disney Research)

SUNLIGHT shining through the window could one day project your favourite picture onto the wall, thanks to a new system that generates complex images by carving intricate patterns into the surface of a transparent sheet.

Shine a light through a wine glass and you'll see refracted slivers of brightness overlaying the glass's shadow. It is complex versions of these bright patterns, called caustics, that are now being exploited to reproduce a photographic image.

Tim Weyrich, a computer graphics researcher at University College London, worked with researchers at Disney Research in Zurich, Switzerland, and Princeton University to manufacture Plexiglas slabs that generate an array of fuzzy elliptical patches which together form a predefined image. Each 10-centimetre-square slab contains over 1000 tiny curved areas that act as lenses to project these bright patches.

Weyrich and his team determine the exact pattern of patches required by looking at the energy distribution of a greyscale image: brighter regions have more energy, while darker ones have less. They then work out the collection of curved patches needed to reproduce this energy distribution.

If that sounds tricky, manufacturing the required surface is even harder. Each curved patch has to be painstakingly carved out by a computer-controlled mill, and producing a single slab can take up to three days. Weyrich hopes this can eventually be speeded up.

Another limitation with the current method is that lighter regions show more detail because they are made up of smaller patches in which the light is more concentrated, compared with the larger patches of more diffuse light making up the dimmer regions. This effect could be avoided by using differently sized carvings in the glass - large ones to focus large amounts of light for highlight areas and smaller ones for the shadows - but that would make designing the surface still more complicated.

Weyrich and colleagues have also applied the techniques to reflected light by manufacturing metallic surfaces that generate highlights in the shape of a desired image. These could be used as a security feature similar to the holograms now imprinted on credit cards, because they would be hard to forge or copy.

Weyrich's system is unlikely to replace simple projectors for producing an image, says Gustavo Patow, a computer graphics researcher at the University of Girona, Spain. But it could find other uses. Car manufacturers could exploit the technique to shape headlight beams into an exact pattern on the road, avoiding the risk of driver glare, Patow suggests. "Being able to control it so finely is amazing."

http://www.newscientist.com/article/mg21028064.900-engraved-plastic-panels-cast-image-in-light-and-shade.html

Internet probe can track you down to within 690 metres

- 15:06 05 April 2011 by **Jacob Aron**

Online adverts could soon start stalking you. A new way of working out where you are by looking at your internet connection could pin down your current location to within a few hundred metres.
Similar techniques are already in use, but they are much less accurate. Every computer connected to the web has an internet protocol (IP) address, but there is no simple way to map this to a physical location. The current best system can be out by as much as 35 kilometres.
Now, Yong Wang, a computer scientist at the University of Electronic Science and Technology of China in Chengdu, and colleagues at Northwestern University in Evanston, Illinois, have used businesses and universities as landmarks to achieve much higher accuracy.
These organisations often host their websites on servers kept on their premises, meaning the servers' IP addresses are tied to their physical location. Wang's team used Google Maps to find both the web and physical addresses of such organisations, providing them with around 76,000 landmarks. By comparison, most other geolocation methods only use a few hundred landmarks specifically set up for the purpose.

Closing in

The new method zooms in through three stages to locate a target computer. The first stage measures the time it takes to send a data packet to the target and converts it into a distance – a common geolocation technique that narrows the target's possible location to a radius of around 200 kilometres.
Wang and colleagues then send data packets to the known Google Maps landmark servers in this large area to find which routers they pass through. When a landmark machine and the target computer have shared a router, the researchers can compare how long a packet takes to reach each machine from the router; converted into an estimate of distance, this time difference narrows the search down further. "We shrink the size of the area where the target potentially is," explains Wang.
Finally, they repeat the landmark search at this more fine-grained level: comparing delay times once more, they establish which landmark server is closest to the target. The result can never be entirely accurate, but it's much better than trying to determine a location by converting the initial delay into a distance or the next best IP-based method. On average their method gets to within 690 metres of the target and can be as close as 100 metres – good enough to identify the target computer's location to within a few streets.

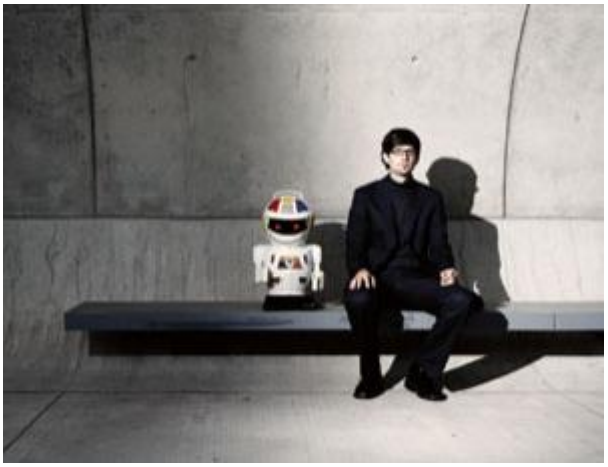
Client independent

That kind of accuracy normally requires people to deliberately disclose their location, but Wang's method works without the user's permission. "This is a client-independent method," as he puts it. "The client does not need to approve anything."
You can avoid any geolocation method by routing traffic through a proxy server, which makes you appear to be elsewhere. Wang can't get around this, but says he can detect proxies and so he can at least return a null result rather than a false positive.
Although Wang's method could potentially allow adverts to target a certain street, advertisers may prefer to retain broader messages. "The majority of brands wouldn't necessarily want to go to that much granularity," says Jack Wallington at the Internet Advertising Bureau in London. He says the method could be useful in certain situations, however, such as targeting hungry office workers with vouchers for nearby takeaway food outlets.
Wang presented the research last week at the Usenix Symposium on Networked Systems Design and Implementation in Boston.

http://www.newscientist.com/article/dn20336-internet-probe-can-track-you-down-to-within-690-metres.html

Bot shows signs of consciousness

- 01 April 2011 by **Celeste Biever**
- Magazine issue 2806.



Conscious minds think alike (Image: Erik Dreyer/Stone/Getty)

A SOFTWARE bot inspired by a popular theory of human consciousness takes the same time as humans to complete simple awareness tasks. Its creators say this feat means we are closer to understanding where consciousness comes from. It also raises the question of whether machines could ever have subjective experiences.

The bot, called LIDA for Learning Intelligent Distribution Agent, is based on "global workspace theory". According to GWT, unconscious processing - the gathering and processing of sights and sounds, for example, is carried out by different, autonomous brain regions working in parallel. We only become conscious of information when it is deemed important enough to be "broadcast" to the global workspace, an assembly of connected neurons that span the brain. We experience this broadcast as consciousness, and it allows information to be shared across different brain regions and acted upon.

Recently, several experiments using electrodes have pinpointed brain activity that might correspond to the conscious broadcast, although how exactly the theory translates into cognition and conscious experience still isn't clear.

To investigate, Stan Franklin, of the University of Memphis in Tennessee, built LIDA - software that incorporates key features of GWT, fleshed out with ideas about how these processes are carried out to produce what he believes to be a reconstruction of cognition.

Franklin based LIDA's processing on a hypothesis that consciousness is composed of a series of millisecond-long cycles, each one split into unconscious and conscious stages. In the first of these stages - unconscious perception - LIDA scans the environment and copies what she detects to her sensory memory. Then specialised "feature detectors" scan sensory memory, pick out certain colours, sounds and movements, and pass these to a software module that recognises them as objects or events. For example, it might discover red pixels and "know" that a red light has been switched on. In the next phase, understanding, which is mainly unconscious, these pieces of data can be strung together and compared with the contents of LIDA's long-term memory. Another set of processes use these comparisons to determine which objects or events are relevant or urgent. For example, if LIDA has been told to look out for a red light, this would be deemed highly salient. If this salience is above a certain threshold, says Franklin, "it suddenly steps over the edge of a cliff; it ignites". That event along with some of its associated content will rise up into consciousness, winning a place in LIDA's global workspace - a part of her "brain" that all other areas can access and learn from. This salient information drives which action is chosen. Then the cycle starts again.

Franklin reckons that similar cycles are the "building blocks for human cognition" and conscious experience. Although only one cycle can undergo conscious broadcast at a time, rather like the individual frames of a

movie, successive broadcasts could be strung together quickly enough to give the sense of a seamless experience (see diagram).
However, just because these cognitive cycles are consistent with some features of human consciousness doesn't mean this is actually how the human mind works. So, with the help of Baars at the Neuroscience Institute in San Diego, California, who first proposed GWT, and philosophy student Tamas Madl at the University of Vienna, Austria, Franklin put LIDA into direct competition with humans.
To increase her chance of success, they grounded the timings of LIDA's underlying processes on known neurological data. For example, they set LIDA's feature detectors to check sensory memory every 30 milliseconds. According to previous studies, this is the time it takes for a volunteer to recognise which category an image belongs to when it is flashed in front of them.
Next the researchers set LIDA loose on two tasks. The first was a version of a reaction-time test in which you must press a button whenever a light turns green. The researchers planted such a light in LIDA's simulated environment, and provided her with a virtual button. It took her on average 280 milliseconds to "hit" the button after the light turned green. The average reaction time in people is 200 milliseconds, which the researchers say is "comparable".
A second task involved a flashing horizontal line that appears first at the bottom of a computer screen and then moves upwards through 12 different positions. When the rate that it shifts up the screen is slow, people report the line as moving. But speed it up and people seem to see 12 flickering lines. When the researchers created a similar test for LIDA, they found that at higher speeds, she too failed to "perceive" that the line was moving. This occurred at about the same speed as in humans. Both results have been accepted for publication in *PLoS One*.
"You tune the parameters and lo and behold you get that data," says Franklin. "This lends support to our hypothesis that there is a single basic building block for all human cognition." Antonio Chella, a roboticist at the University of Palermo in Italy and editor of the *International Journal of Machine Consciousness* agrees: "This may support LIDA, and GWT as a model that captures some aspects of consciousness."
Murray Shanahan, a cognitive roboticist at Imperial College London who also works on computational models of consciousness, says that LIDA is a "high level" model of the mind that doesn't attempt to represent specific neurons or brain structures. This is in contrast to his own lower-level models, but Shanahan points out that both types are needed: "We don't know what the right theory or right level of abstraction is," he says. "We have to let a thousand flowers bloom."
So is LIDA conscious? "I call LIDA functionally conscious," says Franklin, because she uses a broadcast to drive actions and learning. But he draws the line at ascribing "phenomenal consciousness", or subjectivity to her. That said, he reckons there is no reason in principle why she should not be fully conscious one day. "The architecture is right for supporting phenomenal consciousness if we just knew how to bring it about."

Can a computer ever be aware?

At what point does a model of consciousness itself become conscious - if ever?

Antonio Chella of the University of Palermo, Italy, says that before consciousness can be ascribed to software agent LIDA, (see main story) she needs a body. "Consciousness of ourselves, and the world, is based on a continuous interaction between our brain, our body and the world," he says. "I look forward to a LIDA robot."
However, cognitive roboticist Murray Shanahan at Imperial College London says that the robot need not be physical. "It only makes sense to start talking about consciousness in the context of something that interacts in a purposeful way with a spatio-temporal environment," he says. "But I am perfectly happy to countenance a virtual environment."
LIDA's inventor, Stan Franklin of the University of Memphis, reckons LIDA is already "functionally conscious", but makes a distinction between that and subjectivity or "phenomenal consciousness". He is planning to build a version of LIDA that interacts with humans within a complex environment. "When this happens, I may be tempted to attribute phenomenal consciousness to the agent," he says. The trouble is, even if LIDA could have subjective experiences, how would we prove it?
We can't even prove that each of us isn't the only self-aware being in a world of zombies. "Philosophers have been dealing with that for more than 2000 years," says Franklin. Perhaps we will simply attribute subjectivity to computers once they become sufficiently intelligent and communicative, he says.

http://www.newscientist.com/article/mg21028063.400-bot-shows-signs-of-consciousness.html

Evolutionary tug of war inside sweet-potato whitefly

- 19:00 07 April 2011 by **Ferris Jabr**

Under threat from a helpful bacterium? (Image: STR/AFP/Getty)

Trouble could be brewing in the sweet-potato fields of the south-western US. In just six years a bacterium has infected nearly the entire population of a pest that devastated crops in the 1980s and 90s – and the microbe messes with the pest's sex life to help them both spread further.

Infected whiteflies – not true flies but aphid-like pests – produce nearly twice as many offspring as uninfected ones. That's a big problem, because the pest costs millions of dollars in crop damage worldwide.

Martha Hunter of the University of Arizona in Tucson showed that the proportion of whiteflies infected with the bacterium *Rickettsia bellii* in Arizona, New Mexico and California soared from 1 per cent in 2000 to 97 per cent in 2006.

To explain the remarkably swift proliferation, Hunter's colleague Anna Himler replicated the epidemic in the lab. She let a whitefly population, 14 per cent of which were infected with *Rickettsia*, suck the sugary sap from cowpea, melon and cotton plants in the lab. In just five generations the infection rate had soared to between 40 and 80 per cent, making it a good model for what had been observed out of doors.

Vertical rocket

Parasites typically spread in one of two ways: horizontally – in other words, within a generation – or vertically, from parent to offspring. In Himler's set-up, whiteflies that were in close contact but not mating did not infect one another, ruling out horizontal transmission. But when she allowed a male to mate with an infected female, she found that almost all the offspring were infected with *Rickettsia*, suggesting the bacterium is passed from mother to offspring.

What's more, infected females laid far more eggs than their uninfected peers, and more of their offspring survived to adulthood. *Rickettsia* is clearly a boon for the whitefly parents.

Then Himler noticed something else in her data: infected female whiteflies produced far more daughters than sons. That made sense from the bacterium's point of view, since it depends on female whiteflies to increase its own population.

Tug of war

"On the one hand the bacterium benefits its host," says Himler. "But there is also an evolutionary tug of war happening within the whitefly.
"Suddenly the whitefly has a whole new genome inside it and those genes are trying to promote what the bacteria wants," she explains. "It's mutual up to a point. If the sex ratio becomes too skewed, it could become detrimental to the whitefly."
Sweet-potato whitefly was a huge problem for farmers in the south-western US two decades ago, when fields would be besieged by huge clouds of the pests. Today, it is under much stronger control, and if *Rickettsia* and whitefly are preparing a comeback, there are no signs of it yet.
"So far we haven't gotten any reports from local farmers of clouds of whiteflies," Himler says. "If *Rickettsia* is increasing the whitefly's fitness in the wild, it's possible that predators or environmental factors are dampening the effect."
Journal reference: *Science*, DOI: 10.1126/science.1199410

http://www.newscientist.com/article/dn20355-evolutionary-tug-of-war-inside-sweetpotato-whitefly.html

Pulsating planet: Superhot rocks make the Earth roll

- 07 April 2011 by **Caroline Williams**
- Magazine issue 2803.

Gushing larva in Iceland hints at the vast hotspot that created the island (Image: Arctic Images/Corbis)

An invisible force is creating giant ripples in the Earth's crust – in a geological blink of an eye

BRYAN LOVELL likes to show his fellow geologists an image of a network of river valleys. "I ask them where they think this might be on Earth," he says. It is, as you probably guessed, a trick question. The river valleys are in the North Sea, north of Scotland, beneath a kilometre of water and a further 2 kilometres of sediment.

The sea floor here has been slowly sinking ever since it formed. Yet 55 million years ago, something very strange happened. In a geological blink of an eye the sea floor was thrust upwards nearly a kilometre, until it was high and dry above the waves. It remained above the sea for about a million years, long enough for rainwater to carve deep valleys. Then it sank down again. It all happened astonishingly fast.

The big question is why. None of the usual explanations apply. The collision of tectonic plates can lift vast regions many kilometres up into the air, but there are no colliding plates under the North Sea. Sea level can fall when huge ice sheets form, but not by a kilometre and not in only one area. Volcanic hotspots, where hot molten rock rises up from deep within the Earth, can also produce uplift, but the nearest hotspot is hundreds of kilometres to the west, where it has lifted up Iceland. What's more, hotspots produce slow uplift over tens of millions of years, not a relatively sudden rise and fall.

The North Sea is not the only example of a geological jack-in-the-box. Something similar seems to have happened in several regions around the world, including the coast of Angola and the Arabian peninsula. In fact, there are many long-standing geological mysteries of this nature.

Now, at long last, there may be an answer. A team from the University of Cambridge reckons that the likely culprits are pulses of particularly hot rock or, to give them their highly technical name, "hot blobs". These blobs are less dense than the cooler material around them, so when they pop up under the crust they temporarily lift large areas up in the air. In some cases, they appear to spread out in a gradually subsiding circular ripple. (Check out our animated graphic to see how it works). What's more, in many places there may have been a series of pulses, lifting and dropping the land over and over again.

And while hot blobs are most likely to occur at or near major hotspots, the Cambridge team says, they could pop up almost anywhere. If the idea is correct, it could solve a lot of irritating riddles in geology. Maybe even one of the biggest of all: what triggered one of the hottest periods in Earth's history. "It's exciting because you can see ancient problems through new eyes," says Lovell, a member of the team and president of the UK's Geological Society. "We are re-examining observations we've never understood because we didn't have this hypothesis to hand."

Hot blobs

That idea that hot blobs exist in the mantle, the region between Earth's crust and its core, is not new. It has long been known that some parts of the Earth's mantle are hotter than others. In fact, one of the few things known for sure about the mantle is that its temperature, viscosity and density vary widely. This keeps the mantle constantly churning, as hotter and less dense rock rises towards the crust while cooler and denser slabs sink towards the core. This mantle convection is what powers the movement in plate tectonics, and brings heat to volcanoes and to hotspots such as the plumes beneath Hawaii and Iceland.

It is also well known that within hotspots, blobs of particularly hot rock occasionally rise up. Models of the Earth's mantle have suggested that they exist, and there is also solid evidence in the form of changes in the types of volcanic rocks found on the ocean floor. Until recently, however, nobody imagined that these hot pulses could change the Earth's surface dramatically and quickly, or that this could happen away from major hotspots.

The best evidence to support the Cambridge team's claims comes from two areas north of Scotland. By setting off modest explosions and analysing the echoes, it is possible to create detailed three-dimensional maps of what lies beneath the sea floor. Seismic images from the oil industry have revealed ancient land surfaces, now buried beneath 2 kilometres of sediment, with the unmistakable pattern of river valleys. A new, more detailed map is due to be published soon by the Cambridge team.

The seismic evidence is supported by borehole samples. The deepest cores, representing the oldest rocks, contain large numbers of marine fossils. Higher up, and so more recently, coal deposits and pollen suddenly start appearing, along with signs of rivers. Then, a million years later, marine fossils start appearing again.

Gargantuan ripple

What this shows is that about 55 million years ago, the sea floor was much closer to the surface, and was subsiding very slowly. Then, abruptly, an area halfway between Scotland and the Faroe Islands was lifted by at least 800 metres over the course of a million years. Over another million or so years, it sank again.

There is also evidence that another area several hundred kilometres to the east also briefly popped up before sinking back beneath the waves. Afterwards, the slow subsidence of the sea floor resumed, so this old land is now 3 kilometres down.

"Something happened to make a happy marine environment go up by at least 800 metres," says Nicky White, who leads the Cambridge team. That something, the team suggests, was a hot blob coming up the Iceland plume, a few hundred kilometres to the west, hitting the tectonic plate and spreading out like a ripple beneath the North Atlantic at the rate of 40 centimetres per year (*Earth and Planetary Science Letters*, vol 267, p 146).

As the hot ripple spread out it pushed up the land above it, since the lower-density hotter rock took up more space in the mantle than the surrounding rock. Then, as the ripple spread out further, the land behind it was dropped (see "Ups and downs"). Lovell likens the effect to rats running under the carpet. "As the rats run under the rug, it is lifted up then down again. As they get to the edge there is early Scotland, which is lifted higher out of the ocean and then dropped back under the waves," he says. Something similar would have happened all around the ripple and Lovell says there is evidence for a similar uplift on the opposite side of the posited circle, in Greenland.

As if this weren't dramatic enough, newer and as yet unpublished seismic maps have revealed even older land surfaces even deeper beneath the seabed in the same area off Scotland. That suggests that this process did not just happen once, 55 million years ago, but several times. "There is a whole series of these landscapes on top of each other," says White. "Every 2 to 5 million years you get rats under the carpet."

Modelling of a virtual hot blob pulsing up the Iceland plume has convinced the team that, for Scotland at least, the ripple theory stands up. And there are tantalising hints of "rats under carpets" elsewhere. On the coast of Angola in western Africa, for example, a dome 1000 kilometres in diameter was lifted 500 metres in the space of just a couple of million years, starting 5 million years ago. Seismic imaging suggests that there is something particularly hot in the mantle underneath it, says White, so perhaps this hot region pulsed even hotter 5 million years ago. There is also unexplained uplift in the Arabian peninsula that looks a lot like the work of a hot blob, says Lovell.

White and Lovell admit they need more evidence to be sure that hot blobs are at work beyond the North Sea, but say that they are expecting to find more signs of the effect all over the world. "Now we know what we're looking for, I predict we will find it," says Lovell. "Something in the geological record will look odd - it will go up very fast or down very fast. I've been asking my most experienced colleagues, 'Are there breaks in the geological record that you don't understand?' and there are lots of them."

Clint Conrad, a geologist at the University of Hawaii in Honolulu, is intrigued. "The idea that we can get uplift in areas distant from the regions of volcanism is fairly new and indicates that whatever is going on is an aspect of either plumes or mantle flow that we don't completely understand yet."

But he thinks that hot blobs will only show these kinds of dramatic effects where there is already a decent-sized hotspot (see map). Scotland isn't that far from Iceland, he points out, so it is where you would expect to find such an effect if it exists.

The Cambridge team, however, thinks there is no reason that hot pulses couldn't create dramatic - and transient - uplifts almost anywhere, though White advises caution: "We can't invoke blobs everywhere."

If this is right, geologists may have to reassess some long-held assumptions. They have long tried to explain mysterious changes in coastlines by attributing them to global sea-level change due to some unknown ice age, and then used these putative events to date landscapes. "It's circular reasoning," says Lovell.

A bigger implication, though, is Lovell's suggestion that the Scottish hot blob helped trigger an abrupt warming known as the Palaeocene-Eocene thermal maximum. Around 55 million years ago, when Earth was much hotter than today, global temperatures suddenly shot up by 6 °C to 10 °C, causing a minor extinction event. The evidence points to a rise in methane levels, most likely from methane hydrates on the sea floor. This release could have been triggered simply by a rise in ocean temperatures, but uplift of the seabed would also destabilise any methane hydrate deposits. "What we know is that right at the same time this hot blob passed under the North Atlantic, there was a major release of carbon into the atmosphere," Lovell says. "We're not allowed to appeal to coincidences in science, but it's got to be a good candidate."

Computer modelling by two other members of the Cambridge team, John Maclennan and Stephen Jones, has suggested that up to 2000 gigatonnes of carbon might have been released in such a way. "A large methane release of even a few per cent of that figure would be enough to trigger catastrophic climate change," says Euan Nisbet, an earth scientist at Royal Holloway University of London, who has proposed an alternative source for the methane.

There are several other competing ideas about the trigger for the sudden warming, and pinning down the cause will not be easy. Meanwhile, the Cambridge team is intent on looking for more signs that hot blobs have rippled by, or may be at work today. For Lovell, it's all about finding hard evidence. "You can't argue with rocks," he says.

Caroline Williams *is a freelance writer based in London*

http://www.newscientist.com/article/mg20928031.600-pulsating-planet-superhot-rocks-make-the-earth-roll.html

Population expert: The 11-billion-person planet

- 06 April 2011 by **Alison George**
- Magazine issue 2806

One of 7 billion

This year will see the world's 7-billionth person. If only population growth forecasts were as definite, says demographer ***John Bongaarts***

By how much do you think the world's population will grow this century?

The UN predicts that we will reach 9.1 billion in 2050, then the peak will occur around 2070 at 9.4 billion. But it is so far ahead and the margin of uncertainty is huge. We could easily end up with 1 or 2 billion more, or less.

What factors could lead to 11 billion people?

The UN assumes fertility in Africa, for example, will decline steadily from current levels of around four to five children, to around two. It might well go slower than that. Kenya, for example, had a fertility rate of nearly 8 in the 1960s, which came down to around 5 in the 1990s and has remained at that level. This was not expected by the UN, which expects things to go down steadily.

Are there any other reasons why global population might overshoot the UN estimate?

Governments in countries with very low birth rates are now considering implementing pro-natal policies. Most governments in Europe, I think, would like to see their birth rates go up a little bit. If that happens, there will be more Europeans, Japanese and Russians. Also, people might live longer than the UN predicts. The UN assumes that future increases in life expectancy will be slower than in the past. That may be wrong.

Some people think the population will in fact undershoot. What are your thoughts on this?

There are equally possible reasons for undershooting. The most obvious is that fertility in Africa and everywhere could follow the low fertilities of Italy and Spain. This is conceivable but I would be a little doubtful. Countries don't like having low fertility. It leads to a smaller and ageing labour force and a large number of retired people, which is difficult to manage economically.

Isn't it also true that many countries have experienced sharp declines in fertility rates?

Yes, take Asia. If you go back to the 1950s and 1960s, South Korea, Thailand and Indonesia looked just as undeveloped as some African countries now, with high fertility rates. Today Korea and Thailand have fertility rates below 2. So this is quite possible, and depends on how countries develop. It was a very rapid change, though, and could well turn out to be slower elsewhere.

Does HIV/AIDS have an impact on population?
HIV is an example of a disease that people thought would stop growth or reduce Africa's population. That didn't happen. Population growth has such a powerful momentum even such a lethal and massive epidemic had only a fairly modest impact.
The bottom line is, what's your money on if you had to bet on the 2050 world population?
There are very few things that you can predict with any degree of accuracy 40 years from now. But the UN has a good record. In a projection made in 1950 it came close to predicting the actual 2000 population, so I would bet on there being a little over 9 billion people by 2050. Even so, the margin is still plus or minus a billion at least.
Profile
John Bongaarts is vice-president of the Population Council, a research organisation with headquarters in New York. His research focuses on population issues including the impact of the AIDS epidemic and determinants of fertility

http://www.newscientist.com/article/mg21028060.200-population-expert-the-11billionperson-planet.html

Plagues of lemmings driven by winter breeding

- 20:00 17 January 2011 by **Michael Marshall**

Time to find a mate (Bengt Lundberg/Naturepl.com)

Lemming population explosions may be powered by their ability to breed through the long, dark Arctic winters. The finding adds to evidence that lemmings will be hit hard by climate change.

Rolf Ims and colleagues at the University of Tromsø trapped Norway lemmings and grey red-backed voles at 109 locations in north-east Norway to monitor population changes before, during and after a lemming population outbreak.

As the winter went on, the population of lemmings living under the snow at each site rose, while vole populations fell. In the spring, the lemming population was large enough to fuel an outbreak. Although the vole population also saw a large rise, it happened at a much slower rate.

Snow business

This suggests the lemmings' huge outbreaks are largely driven by their winter behaviour, rather than external factors like food supply or predators, which should have had a similar impact on vole populations. Ims thinks this evolved to help the animals escape summer predators.

Lemmings bred fastest at high altitudes thanks to longer-lasting snow – but rising temperatures could see these snow-covered areas shrink, fragmenting lemming populations, says Ims.

Ideal winters for lemmings are becoming less common, says agrees Ilkka Hanski of the University of Helsinki in Finland. But Charles Krebs of the University of British Columbia in Vancouver, Canada, is not yet convinced that climate change will harm lemmings. He says that what is needed now is a detailed study of lemming populations living under the snow – but concedes that this is "difficult and expensive" with current existing technology.

Journal reference: *Proceedings of the National Academy of Sciences*, DOI: 10.1073/pnas.1012714108

http://www.newscientist.com/article/dn19982-plagues-of-lemmings-driven-by-winter-breeding.html

Virtual Reality Lab Focuses on Conservation

If a tree falls in a virtual reality forest, will anyone hear an environmental message? They will, as long as they were the ones who cut down the make-believe redwood. (Credit: Image courtesy of Stanford University)

ScienceDaily (Apr. 8, 2011) — Timber! Cutting down a tree in a virtual forest can bring new ideas of conservation crashing down on you. If a tree falls in a virtual reality forest, will anyone hear an environmental message? They will, as long as they were the ones who cut down the make-believe redwood.

New findings from Stanford researchers show that people who were immersed in a three-dimensional virtual forest and told to saw through a towering sequoia until it crashed in front of them later used less paper in the real world than people who only imagined what it's like to cut down a tree.

"We found that virtual reality can change how people behave," said Sun Joo Ahn, whose doctoral dissertation outlines the findings. "That's the big result. When people are in virtual reality and going through the motions of actually cutting down this tree, it might make them feel more personally accountable or responsible for the damage that occurred."

Ahn's work is among the latest batch of studies to come from Stanford's Virtual Human Interaction Lab. Led by Jeremy Bailenson, associate professor of communication, researchers in the lab are trying to better understand how advances in digital media like 3-D movies and interactive video games are affecting people's real-life experiences. And they want to know how those technologies can influence and change people's behavior.

"People want -- and are becoming more used to -- immersive media experiences," said Bailenson, co-author of the recently released book Infinite Reality: Avatars, Eternal Life, New Worlds, and the Dawn of the Virtual Revolution. "You're going to need more than an instructional video or a pamphlet to explain something that requires a change in behavior. You need to make people feel like they're literally engaged."

In one of her studies, Ahn had about 50 people read some information about how the use of non-recycled paper leads to deforestation.

She then had one group of subjects read an account of what happens when a chainsaw buzzes through a tree. The piece was rich with detail, describing the chirping birds in the forest, the sound and vibration of the saw and the snapping of branches that comes with the crash of the mighty redwood.

A second group of subjects didn't read the description, but instead were plunged into the virtual forest. Outfitted with a helmet-like device that cut off their vision from the real world and surrounded them with the sights and sounds of a computerized woodland, they felt like they were there.

Using a special joystick called a haptic device, the subjects were able to control the back-and-forth motions of the chainsaw that their virtual selves used to cut down the tree. As they sawed for about three minutes, the haptic device vibrated in their hands to simulate the feeling of the real thing.

Regardless of which group they were in, all the participants said they had a stronger belief that their personal actions could improve the quality of the environment compared to how they felt before they either read about tree cutting or chopped down an evergreen in the fake forest.

But when it came time to put that belief into practice, only the tree choppers cut their paper use.

Before letting them leave the lab, Ahn had the subjects in both groups sit at a desk and fill out some forms. She placed a stack of paper napkins and a glass of water on the desk and pretended to accidentally knock the

glass over. The subjects reflexively grabbed napkins to clean the spill, and Ahn later counted how many were used.

Those who only read about logging used an average of 20 percent more napkins than the virtual lumberjacks.

"This study isn't all about trees," said Ahn, who will receive her PhD this summer and begin teaching as an assistant professor at the University of Georgia's Grady College of Journalism and Mass Communication in the fall.

"It's about how we are able to use an immersive virtual environment to create a change in behavior in the physical world," she said. "We showed that just three minutes of an embodied experience could produce a behavioral result."

That implies that repeated or long-term exposure to virtual reality scenarios can produce even more dramatic results, she said.

And understanding that interplay between virtual and actual reality is at the heart of the work under way in Bailenson's lab. Long a proving ground for studies that show how interacting with an avatar can motivate someone to increase their retirement savings, exercise more or vote for a particular politician, the lab is going through a transformation of its own.

Expected to open by the end of April, a newly built space for virtual reality research will feature what Bailenson calls the world's most technologically advanced "multi-sensory room" -- an area that integrates sight, sound and touch into one immersive digital experience.

Test subjects will experience the virtual world with a head-mounted display that will give them complete peripheral vision and a 360-degree view of whatever landscape Bailenson and his researchers design. The room will have 24 speakers that mimic the movement of sound: Imagine watching a virtual bird flying by your eyes as the sound of its tweeting and chirping follows along.

"If you've seen a movie in a really state-of-the-art theater with great surround sound, this is like that -- but on steroids," Bailenson said.

The new lab will also feature a floor that moves and shakes, allowing researchers to duplicate the feel of earthquakes, approaching footsteps and explosions.

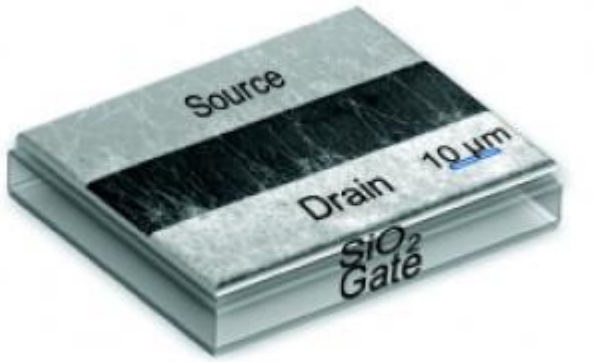
"The next time a tree crashes," Bailenson said, "it will shake your boots."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Stanford University**. The original article was written by Adam Gorlick.

http://www.sciencedaily.com/releases/2011/04/110408163908.htm

New Research Advances Understanding of Lead Selenide Nanowires



Lead selenide nanowires integrated in a device. (Credit: Image courtesy of University of Pennsylvania)

ScienceDaily (Apr. 8, 2011) — The advancements of our electronic age rests on our ability to control how electric charge moves, from point A to point B, through circuitry. Doing so requires particular precision, for applications ranging from computers, image sensors and solar cells, and that task falls to semiconductors. Now, a research team at the University of Pennsylvania's schools of Engineering and Applied Science and Arts and Sciences has shown how to control the characteristics of semiconductor nanowires made of a promising material: lead selenide.

Led by Cherie Kagan, professor in the departments of Electrical and Systems Engineering, Materials Science and Engineering and Chemistry and co-director of Pennergy, Penn's center focused on developing alternative energy technologies, the team's research was primarily conducted by David Kim, a graduate student in the Materials Science and Engineering program.

The team's work was published online in the journal *ACS Nano* and will be featured in the Journal's April podcast.

The key contribution of the team's work has to do with controlling the conductive properties of lead selenide nanowires in circuitry. Semiconductors come in two types, *n* and *p*, referring to the negative or positive charge they can carry. The ones that move electrons, which have a negative charge, are called "n-type." Their "p-type" counterparts don't move protons but rather the absenceof an electron -- a "hole" -- which is the equivalent of moving a positive charge.

Before they are integrated into circuitry, the semiconductor nanowire must be "wired up" into a device. Metal electrodes must be placed on both ends to allow electricity to flow in and out; however, the "wiring" may influence the observed electrical characteristics of the nanowires, whether the device appears to be *n*-type or *p*-type. Contamination, even from air, can also influence the device type. Through rigorous air-free synthesis, purification and analysis, they kept the nanowires clean, allowing them to discover the unique properties of these lead selenide nanomaterials.

Researchers designed experiments allowing them to separate the influence of the metal "wiring" on the motion of electrons and holes from that of the behavior intrinsic to the lead selenide nanowires. By controlling the exposure of the semiconductor nanowire device to oxygen or the chemical hydrazine, they were able to change the conductive properties between *p*-type and *n*-type. Altering the duration and concentration of the exposure, the nanowire device type could be flipped back and forth.

"If you expose the surfaces of these structures, which are unique to nanoscale materials, you can make them *p*-type, you can make them *n*-type, and you can make them somewhere in between, where it can conduct both electrons and holes," Kagan said. "This is what we call 'ambipolar.'"

Devices combining one *n*-type and one *p*-type semiconductor are used in many high-tech applications, ranging from the circuits of everyday electronics, to solar cells and thermoelectrics, which can convert heat into electricity.

"Thinking about how we can build these things and take advantage of the characteristics of nanoscale materials is really what this new understanding allows," Kagan said.

Figuring out the characteristics of nanoscale materials and their behavior in device structures are the first steps in looking forward to their applications.
These lead selenide nanowires are attractive because they may be synthesized by low-cost methods in large quantities.
"Compared to the big machinery you need to make other semiconductor devices, it's significantly cheaper," Kagan said. "It doesn't look much more complicated than the hoods people would recognize from when they had to take chemistry lab."
In addition to the low cost, the manufacturing process for lead selenide nanowires is relatively easy and consistent.
"You don't have to go to high temperatures to get mass quantities of these high-quality lead selenide nanowires," Kim said. "The techniques we use are high yield and high purity; we can use all of them."
And because the conductive qualities of the lead selenide nanowires can be changed while they are situated in a device, they have a wider range of functionality, unlike traditional silicon semiconductors, which must first be "doped" with other elements to make them "*p*" or "*n*."
The Penn team's work is a step toward integrating these nanomaterials in a range of electronic and optoelectronic devices, such as photo sensors.
The research was conducted by Kim and Kagan, along with Materials Science and Engineering undergraduate and graduate students Tarun R. Vemulkar and Soong Ju Oh; Weon-Kyu Koh, a graduate student in Chemistry; and Christopher B. Murray, a professor in Chemistry and in Materials Science and Engineering.
This work was supported with funding from the National Science Foundation Division of Materials Research, the National Science Foundation Solar Program and the National Science Foundation Nano-Bio Interface Center.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Pennsylvania**.

Journal Reference:

1. David K. Kim, Tarun R. Vemulkar, Soong Ju Oh, Weon-Kyu Koh, Christopher B. Murray, Cherie R. Kagan. **Ambipolar and Unipolar PbSe Nanowire Field-Effect Transistors**. *ACS Nano*, 2011; 110321110927018 DOI: 10.1021/nn200348p

http://www.sciencedaily.com/releases/2011/04/110408114352.htm

Are Invasive Plants a Threat to Native Biodiversity? It Depends on the Spatial Scale

Purple loosestrife in waterway. The phrase "invasive plant species" typically evokes negative images such as broad swaths of kudzu smothered trees along the highway or purple loosestrife taking over wetlands and clogging waterways -- and as such, invasive plants are largely viewed as major threats to native biodiversity. However, research has shown both that invasive species may be one of the most important threats to biodiversity and that plant invasions are rarely the cause for native species extinctions. How can these conflicting pieces of evidence be reconciled? (Credit: © pmstephens / Fotolia)

ScienceDaily (Apr. 11, 2011) — The phrase "invasive plant species" typically evokes negative images such as broad swaths of kudzu smothered trees along the highway or purple loosestrife taking over wetlands and clogging waterways -- and as such, invasive plants are largely viewed as major threats to native biodiversity. However, research has shown both that invasive species may be one of the most important threats to biodiversity and that plant invasions are rarely the cause for native species extinctions. How can these conflicting pieces of evidence be reconciled?

Kristin Powell, from Washington University, MO, was interested in determining whether some of the differences in the effects that invasive plant species had on biodiversity was in fact due to the spatial scales at which they were studied.

"Biological invasions are often thought to be one of the leading threats to global biodiversity," Powell comments. "However, recent studies and popular literature have begun to question this view, especially in the context of invasive plants, asking 'Are invasive species really that bad?' For example, invasive plants have never been implicated as the sole cause in driving a native plant extinct."

To tackle this apparent conundrum, Powell and her co-authors took a two-prong approach; first, they conducted a meta-analysis to synthesize results from as many previous studies on the subject as they could find, and then they developed a model to investigate mechanisms that might explain their results. They published their findings in the recent Biodiversity Special Issue of the *American Journal of Botany*.

Powell and her colleagues found 57 studies containing information on average species richness with and without invaders. They used a meta-analysis because it is a powerful tool that allows each study to be used as a separate data set, to some degree. By comparing the difference in species richness between plots with and without invasive plant species and regressing that against the studies' plot sizes the authors were able to see if a meaningful relationship existed between spatial scale and the effect of invaders.

Indeed, they found a negative relationship between area and species richness. While invasive plant species at small spatial scales (plots < 100 m2) severely decreased native species richness, the impact of the invasive species decreased as the size of the study plot increased.

"Our meta-analysis reconciles the opposing views on invaders by finding that invasive plants cause a large loss in biodiversity at small scales, but this effect essentially disappears at broader scales," explains Powell. "That is, invasive plants are much more likely to cause extinctions at local but not regional or island-level spatial scales." Furthermore, while invasive species may lead to native plant extinctions at the local-level, it may take decades, centuries, or even longer for these plant species to become extirpated at the regional or global level.

How can this disparate effect of invasive plants at small versus large spatial scales possibly be explained?

To explore a potential mechanism for this effect, Powell and her colleagues developed a model based on the idea that invasive plants might change the abundance and structural pattern of native plants -- depending on how many rare and common species are present -- which in turn might explain these differences.
In the model the authors randomly assigned 150 native species to occupy a certain number of patches within a simulated area. Then an invading species took over 90% of the patches, causing almost half of the native species in each patch to decline to extinction. In some simulations the invader negatively impacted common species more than rare ones, and vice versa.
The authors found some very interesting results. At the local scale invading species always resulted in a loss of native species. However, the outcomes differed at the regional (larger) scale. When the invader impacted the common species more, diversity at the regional level was unaffected (it was the same in plots with or without invaders). But when rarer species were disproportionally affected, diversity at the regional level was much lower in invaded than uninvaded plots. Thus, as the effect of the invader changed from having proportionally greater effects on common to rare species, the potential for extinctions at the regional level increased, as long as there was a large number of rare species in the community.
In other words, in order for invasive species to drive native species extinct at the regional (or broader scale) level the model indicated that the system must have many rare species which are strongly and disproportionally influenced by invasive species relative to the more widespread, common species. In all other scenarios, invasive species would have bigger or similar impacts at the local rather than the regional scale -- which is what the meta-analysis, based on the literature, also showed.
"It is not surprising that invasive plants cause larger declines in diversity at smaller spatial scales, as plant competition is a local, ecological process," Powell notes.
"One process that can lead to fewer native plant extinctions at broader scales is if invasive plants generally affect common species proportionately more than rare species" Powell states. "We are currently investigating if there are commonalities across several plant invasions in how strongly common versus rare plant species are affected by invasive plants."
Powell emphasizes that it is important to understand the local-scale processes that contribute to the loss of biodiversity from plant invasions and that future research should examine the impacts of invasives across local and regional spatial scales. "The local-scale reduction of diversity by invasives is also the scale at which ecosystem services can be altered by invasive species." Interestingly, one of the invasive species she and her colleagues have been studying, Amur honeysuckle, has been shown to decrease bird nesting success, decrease survivorship of frog tadpoles in nearby ponds, and increase the risk of tick-borne illness in humans. "Through local-scale effects, invasive plants can also alter population and meta-population dynamics of native species, which may lead to broad-scale extinctions in the future," Powell concludes.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **American Journal of Botany**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. K. I. Powell, J. M. Chase, T. M. Knight. **A synthesis of plant invasion effects on biodiversity across spatial scales**. *American Journal of Botany*, 2011; 98 (3): 539 DOI: 10.3732/ajb.1000402

http://www.sciencedaily.com/releases/2011/04/110408163917.htm

Some Features of Human Face Perception Are Not Uniquely Human, Pigeon Study Shows

University of Iowa researchers found that pigeons recognize a human face's identity and emotional expression in much the same way as people do. Image shows example of face stimuli shown to the pigeons in the experiments conducted by Soto and Wasserman. (Credit: Journal of Vision)

ScienceDaily (Apr. 11, 2011) — When it comes to picking a face out of a police lineup, would you guess that you would use some of the same processes a pigeon might use?

If you said "yes," then you're right.

A study published by two University of Iowa researchers in the March 31 issue of the *Journal of Vision* found that pigeons recognize a human face's identity and emotional expression in much the same way as people do. Pigeons were shown photographs of human faces that varied in the identity of the face, as well as in their emotional expression -- such as a frown or a smile. In one experiment, pigeons, like humans, were found to perceive the similarity among faces sharing identity and emotion. In a second, key experiment, the pigeons' task was to categorize the photographs according to only one of these dimensions and to ignore the other. The pigeons found it easier to ignore emotion when they recognized face identity than to ignore identity when they recognized face emotion, according to Ed Wasserman, Stuit Professor of Experimental Psychology, and graduate student Fabian Soto, both of the UI College of Liberal Arts and Sciences Department of Psychology.

"This asymmetry has been found many times in experiments with people and it has always been interpreted as the result of the unique organization of the human face processing system." Soto said. "We have provided the first evidence suggesting that this effect can arise from perceptual processes present in other vertebrates.

"The point of the project is not that pigeons perceive faces just as we do or that people do not have specialized processes for face perception. Rather, the point is that both specialized and general processes are likely to be involved in peoples' recognition of faces and that the contributions of each should be carefully determined empirically," he added.

In fact, the findings could make scientists reconsider their assumptions about how uniquely human cognitive processes might interact with more general processes in complex tasks such as face recognition.

"It is a popular practice among researchers in perception and cognition to speculate about specialized mechanisms without offering convincing empirical data to support their ideas. We hope that our research will prompt other researchers to conduct more comparative work to assess their claims about the evolution of uniquely human perceptual and cognitive processes," Wasserman said.

The researchers studied pigeons in this project because they have excellent vision and are not close evolutionary relatives of humans. Pigeons do not have a specialized system for face processing, but they still show similarities to people when they are trained to recognize human faces. The simplest interpretation of these similarities is that they result from general recognition processes shared by both species.

The experiments were conducted in Wasserman's laboratory in 2009 and 2010.
The research was funded by grants from the National Institute of Mental Health and the National Eye Institute.

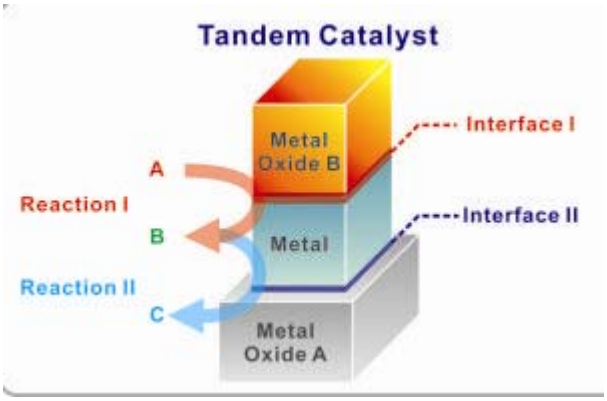
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Iowa Health Care**.

Journal Reference:

1. F. A. Soto, E. A. Wasserman. **Asymmetrical interactions in the perception of face identity and emotional expression are not unique to the primate visual system**. *Journal of Vision*, 2011; 11 (3): 24 DOI: 10.1167/11.3.24

http://www.sciencedaily.com/releases/2011/04/110411171847.htm

'Green Energy' Advance: Tandem Catalysis in Nanocrystal Interfaces



In a unique new bilyaer nanocatalyst system, single layers of metal and metal oxide nanocubes are deposited to create two distinct metal–metal oxide interfaces that allow for multiple, sequential catalytic reactions to be carried out selectively and in tandem. (Credit: Image courtesy of Yang group)

ScienceDaily (Apr. 11, 2011) — In a development that holds intriguing possibilities for the future of industrial catalysis, as well as for such promising clean green energy technologies as artificial photosynthesis, researchers with the U.S. Department of Energy (DOE)'s Lawrence Berkeley National Laboratory (Berkeley Lab) have created bilayered nanocrystals of a metal-metal oxide that are the first to feature multiple catalytic sites on nanocrystal interfaces. These multiple catalytic sites allow for multiple, sequential catalytic reactions to be carried out selectively and in tandem.

"The demonstration of rationally designed and assembled nanocrystal bilayers with multiple built-in metal-metal oxide interfaces for tandem catalysis represents a powerful new approach towards designing high-performance, multifunctional nanostructured catalysts for multiple-step chemical reactions," says the leader of this research Peidong Yang, a chemist who holds joint appointments with Berkeley Lab's Materials Sciences Division, and the University of California Berkeley's Chemistry Department and Department of Materials Science and Engineering.

Yang is the corresponding author of a paper describing this research that appears in the journal *Nature Chemistry*. Co-authoring the paper were Yusuke Yamada, Chia-Kuang Tsung, Wenyu Huang, Ziyang Huo, Susan Habas, Tetsuro Soejima, Cesar Aliaga and leading authority on catalysis Gabor Somorjai.

Catalysts -- substances that speed up the rates of chemical reactions without themselves being chemically changed -- are used to initiate virtually every industrial manufacturing process that involves chemistry. Metal catalysts have been the traditional workhorses, but in recent years, with the advent of nano-sized catalysts, metal,oxide and their interface have surged in importance.

"High-performance metal-oxide nanocatalysts are central to the development of new-generation energy conversion and storage technologies," Yang says. "However, to significantly improve our capability of designing better catalysts, new concepts for the rational design and assembly of metal-metal oxide interfaces are needed."

Studies in recent years have shown that for nanocrystals, the size and shape -- specifically surface faceting with well-defined atomic arrangements -- can have an enormous impact on catalytic properties. This makes it easier to optimize nanocrystal catalysts for activity and selectivity than bulk-sized catalysts. Shape- and size-controlled metal oxide nanocrystal catalysts have shown particular promise.

"It is well-known that catalysis can be modulated by using different metal oxide supports, or metal oxide supports with different crystal surfaces," Yang says. "Precise selection and control of metal-metal oxide interfaces in nanocrystals should therefore yield better activity and selectivity for a desired reaction."

To determine whether the integration of two types of metal oxide interfaces on the surface of a single active metal nanocrystal could yield a novel tandem catalyst for multistep reactions, Yang and his coauthors used the Lamgnuir-Blodgett assembly technique to deposit nanocube monolayers of platinum and cerium oxide on a silica (silicon dioxide) substrate. The nanocube layers were each less than 10 nanometers thick and stacked one on top of the other to create two distinct metal-metal oxide interfaces -- platinum-silica and cerium oxide-platinum. These two interfaces were then used to catalyze two separate and sequential reactions. First, the

cerium oxide-platinum interface catalyzed methanol to produce carbon monoxide and hydrogen. These products then underwent ethylene hydroformylation through a reaction catalyzed by the platinum-silica interface. The final result of this tandem catalysis was propanal.

"The cubic shape of the nanocrystal layers is ideal for assembling metal-metal oxide interfaces with large contact areas," Yang says. "Integrating binary nanocrystals to form highly ordered superlattices is a new and highly effective way to form multiple interfaces with new functionalities."

Yang says that the concept of tandem catalysis through multiple interface design that he and his co-authors have developed should be especially valuable for applications in which multiple sequential reactions are required to produce chemicals in a highly active and selective manner. A prime example is artificial photosynthesis, the effort to capture energy from the sun and transform it into electricity or chemical fuels. To this end, Yang leads the Berkeley component of the Joint Center for Artificial Photosynthesis, a new Energy Innovation Hub created by the U.S. Department of Energy that partners Berkeley Lab with the California Institute of Technology (Caltech).

"Artificial photosynthesis typically involves multiple chemical reactions in a sequential manner, including, for example, water reduction and oxidation, and carbon dioxide reduction," says Yang. "Our tandem catalysis approach should also be relevant to photoelectrochemical reactions, such as solar water splitting, again where sequential, multiple reaction steps are necessary. For this, however, we will need to explore new metal oxide or other semiconductor supports, such as titanium dioxide, in our catalyst design."

This research was supported by the DOE Office of Science.

Story Source:

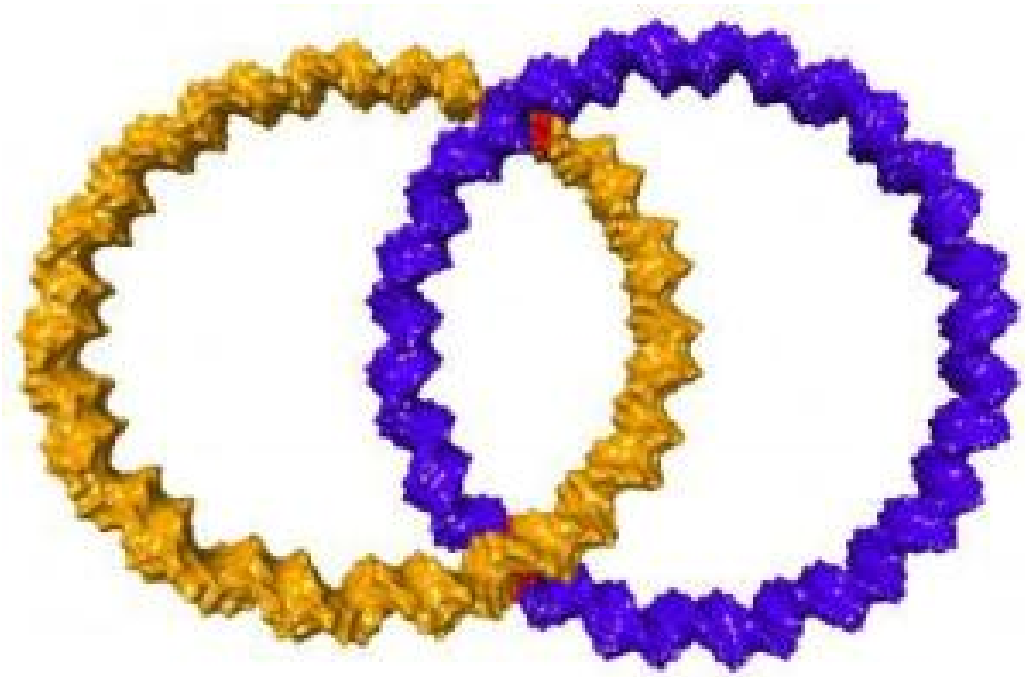
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **DOE/Lawrence Berkeley National Laboratory**.

Journal Reference:

1. Yusuke Yamada, Chia-Kuang Tsung, Wenyu Huang, Ziyang Huo, Susan E. Habas, Tetsuro Soejima, Cesar E Aliaga, Gabor A. Somorjai, Peidong Yang. **Nanocrystal bilayer for tandem catalysis**. *Nature Chemistry*, 2011; DOI: 10.1038/nchem.1018

http://www.sciencedaily.com/releases/2011/04/110411142311.htm

World's Smallest Wedding Rings: Interlocking Rings of DNA Visible Through Scanning Force Microscope



The world's smallest wedding rings are built up by two interlocked DNA-strands. (Credit: Alexander Heckel)

ScienceDaily (Apr. 11, 2011) — DNA nanotechnology makes use of the ability of natural DNA strains' capacity for self asssembly. Prof. Alexander Heckel and his doctoral student Thorsten Schmidt of Goethe University were able to create two rings of DNA only 18 nanometers in size, and to interlock them like two links in a chain. Such a structure is called catenan, a term derived from the Latin word catena (chain). Schmidt, who got married during the time he was working on the nano-rings, believes that they are probably the world's smallest wedding rings.

From a scientific perspective, the structure is a milestone in the field of DNA nanotechnology, since the two rings of the catenan are, as opposed to the majority of the DNA nano-architectures that have already been realized, not fixed formations, but -- depending on the environmental conditions -- freely pivotable. They are therefore suitable as components of molecular machines or of a molecular motor.

"We still have a long way to go before DNA structures such as the catenan can be used in everyday items," says Prof Alexander Heckel, "but structures of DNA can, in the near future, be used to arrange and study proteins or other molecules that are too small for a direct manipulation, by means of auto-organization." This way, DNA nano-architectures could become a versatile tool for the nanometer world, to which access is difficult.

In the manufacture of DNA nano-architecture, the scientists take advantage of the pairing rules of the four DNA nucleobases, according to which two natural DNA strands can also find each other (in DNA nano-architecture, the base order is without biological significance). An A on one strand pairs with T on the other strand and C is complementary to G. The trick is to create the sequences of the DNA strands involved in such a manner as to ensure that the desired structure builds up on its own without direct intervention on the experimenter's part. If only certain parts of the strands used complement each other, branches and junctions can be created.

As reported by Schmidt and Heckel in the journal *Nano Letters*, they first created two C-shaped DNA fragments for the catenans. With the help of special molecules that act as sequence-specific glue for the double helix, they arranged the "Cs" in such a ways as to create two junctions, with the open ends of the "Cs" pointing away from each other. The catenan was created by adding two strands that attach to the ends of the two ring fragments, which are still open. Thorsten Schmidt dedicated the publication to his wife Dr Diana

Gonçalves Schmidt, who also appreciates the work on scientific level, since she was also a part of Alexander Heckel's work group.
Since they are much smaller than the wavelengths of visible light, the rings cannot be seen with a standard microscope. "You would have to string together about 4000 such rings to even achieve the diameter of a human hair," says Thorsten Schmidt. He therefore displays the catenans with a scanning force microscope, which scans the rings that have been placed on a surface with an extremely fine tip.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Goethe University Frankfurt**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Thorsten L. Schmidt, Alexander Heckel. **Construction of a Structurally Defined Double-Stranded DNA Catenane**. *Nano Letters*, 2011; 110316152409054 DOI: 10.1021/nl200303m

http://www.sciencedaily.com/releases/2011/04/110411131348.htm

New Citrus Variety Is Very Sweet, Juicy and Low-Seeded

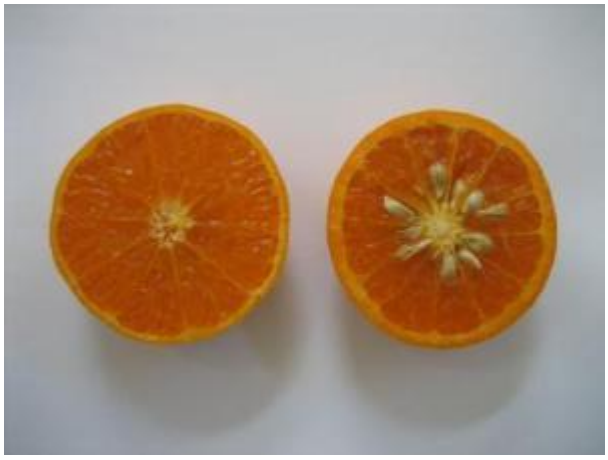


Photo compares the 'KinnowLS' (left) with 'Kinnow.' While "Kinnow" has 15-30 seeds per fruit, "KinnowLS" has only 2-3 seeds per fruit. Rarely, individual "KinnowLS" fruit may have 4-7 seeds. (Credit: T. Williams, UC Riverside)

ScienceDaily (Apr. 11, 2011) — Juicy. Extremely Sweet. Visually attractive. Easy to peel. Low seeded. These are the fine qualities that mark 'KinnowLS,' the latest citrus variety released by researchers at the University of California, Riverside.

Large-sized for a mandarin, the fruit has an orange rind color. The rind is thin and extremely smooth. The 10-11 segments in each fruit are fleshy and deep orange in color.

'KinnowLS' (the LS is short for low seeded) is a mandarin selection developed by mutation breeding of the mandarin cultivar 'Kinnow,' a mid-to-late season maturing variety developed by UC Riverside nearly 100 years ago. While 'Kinnow' has 15-30 seeds per fruit, 'KinnowLS' has only 2-3 seeds per fruit. Rarely, individual 'KinnowLS' fruit may have 4-7 seeds.

"People who like very sweet fruit are going to find 'KinnowLS' to be very appealing," said Mikeal Roose, a professor of genetics in, and chair of, the Department of Botany and Plant Sciences, who developed 'KinnowLS' along with staff scientist Timothy Williams. "When other citrus varieties mature to reach the level of sweetness of 'KinnowLS,' their other qualities -- such as rind texture -- are in decline. Neither 'Kinnow' nor 'KinnowLS' suffer in this way."

Yet another attractive quality of 'KinnowLS' is that it can be grown in California's desert regions because the fruit, which matures during February through April, does well in hot climates.

'Kinnow' is the most important mandarin in the Punjab regions of India and Pakistan, where 'Kinnow' fruit trees constitute about 80 percent of all citrus trees.

"But the fruit, which is popular there, is seedy," Roose said. "Therefore, 'KinnowLS' has very good potential in this area of the world."

Growers in India and Pakistan will have to wait a few years, however, before 'KinnowLS' trees can strike roots there. Currently, plans are to distribute 'KinnowLS' budwood, starting June 2011, to only licensed nurseries in California. (In November 2010, UCR distributed a few trees to a handful of California nurseries for the sole purpose of creating a bigger budwood supply.) For three years, only California nurseries will be permitted to propagate 'KinnowLS.' Licenses for 'KinnowLS' propagation outside the United States will be issued thereafter.

'KinnowLS' will not arrive in U.S. produce aisles for at least five years.

"It generally takes about that long to propagate citrus trees," Roose said.

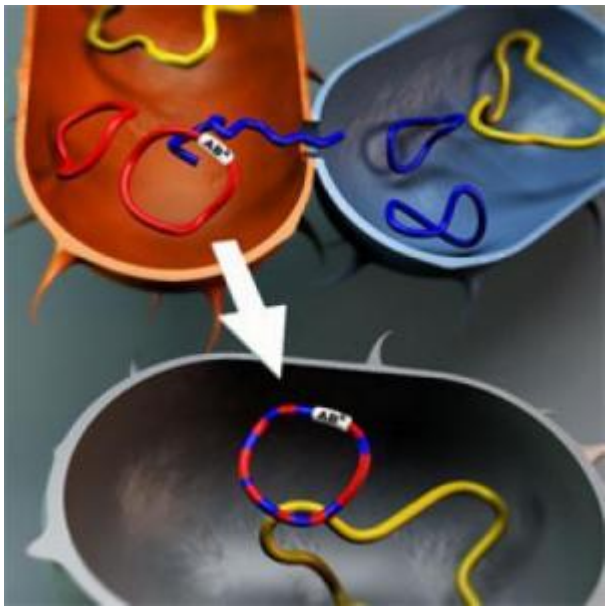
Citrus is grown by 'budding,' not by planting a seed. This is because trees grown from a citrus seed are often quite different from the mother tree and the trees may be fruitless for many years. To circumvent these problems, growers and researchers grow seedlings from citrus seeds and then tightly splice onto their rootstock seedling a small amount of material, called a bud, from a tree of the desired variety.

When a new variety is released, citrus nurseries get a few buds from which they make "mother" trees. Buds from these trees make many "increase" trees, and then buds from the increase trees are used to make the trees sold to growers.
"These cycles take time," Roose said. "After the grower plants trees, they do not have much fruit until the third year after planting."
Mutation breeding is a technique commonly used by plant scientists to produce useful and desired traits in crops -- e.g., larger seeds, new colors, or sweeter fruits -- that either cannot be found in nature or have been lost during evolution. The mutations -- changes in the structure of genes -- are artificially induced by treatment with certain physical or chemical agents. In nature, spontaneous mutations, which are mutations that occur naturally, occasionally take place; mutation breeding can speed this up.
Currently, UCR has 12 'KinnowLS' trees. Six other locations in California each have a dozen 'KinnowLS' trees also.
The development of 'KinnowLS' was funded by the California Citrus Research Board, the California Citrus Nursery Board and the UCR Agricultural Experiment Station.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of California - Riverside**.

http://www.sciencedaily.com/releases/2011/04/110411171849.htm

Antibiotic Resistance Spreads Rapidly Between Bacteria



Antibiotic resistance-carrying plasmids from different bacteria can meet and exchange genetic material. The result is plasmids consisting of genes that have each been adapted to different bacterial species. This facilitates further adaptation and mobility, and consequently also the spread of antibiotic resistance between different bacterial species. (Credit: Björn Norberg)

ScienceDaily (Apr. 11, 2011) — The part of bacterial DNA that often carries antibiotic resistance is a master at moving between different types of bacteria and adapting to widely differing bacterial species, shows a study made by a research team at the University of Gothenburg in cooperation with Chalmers University of Technology.

The results are published in an article in the scientific journal *Nature Communications.*

More and more bacteria are becoming resistant to our common antibiotics, and to make matters worse, more and more are becoming resistant to all known antibiotics. The problem is known as multi-resistance, and is generally described as one of the most significant future threats to public health Antibiotic resistance can arise in bacteria in our environment and in our bodies. Antibiotic resistance can then be transferred to the bacteria that cause human diseases, even if the bacteria are not related to each other.

A large proportion of gene transfer between bacteria takes place with the aid of what are known as conjugative plasmids, a part of the bacterial DNA. A plasmid can only exist and multiply inside a cell, where it uses the cell's machinery, but can then be transferred to another cell and in that way spread between bacteria.

The research team has studied a group of the known carriers of antibiotic resistance genes: IncP-1 plasmids. Using advanced DNA analysis, the researchers have succeeded in mapping the origin of different IncP-1 plasmids and their mobility between different bacterial species. "Our results show that plasmids from the IncP-1 group have existed in, and adapted to, widely differing bacteria. They have also recombined, which means that a single plasmid can be regarded as a composite jigsaw puzzle of genes, each of which has adapted to different bacterial species," says Peter Norberg, a researcher in the Institute of Biomedicine at the University of Gothenburg. This indicates very good adaptability and suggests that these plasmids can move relatively freely between, and thrive in, widely differing bacterial species.

"IncP-1 plasmids are very potent 'vehicles' for transporting antibiotic resistance genes between bacterial species. Therefore, it does not matter much in what environment, in what part of the world, or in what bacterial species antibiotic resistance arises. Resistance genes could relatively easily be transported from the original environment to bacteria that infect humans, through IncP-1 plasmids, or other plasmids with similar properties, as 'vehicles'," says Professor Malte Hermansson of the Department of Cell and Molecular Biology at the University of Gothenburg.

It has been known for some time that plasmids are important in the spread of antibiotic resistance. The research team's findings show that IncP-1 plasmids can move, and have moved, between widely differing bacterial species and in addition have interacted directly with one another, which can increase the potential for gene spreading.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Gothenburg**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Peter Norberg, Maria Bergström, Vinay Jethava, Devdatt Dubhashi, Malte Hermansson. **The IncP-1 plasmid backbone adapts to different host bacterial species and evolves through homologous recombination**. *Nature Communications*, 2011; 2: 272 DOI: 10.1038/ncomms1267

http://www.sciencedaily.com/releases/2011/04/110411163918.htm

Tuberculosis Strain Spread by the Fur Trade Reveals Stealthy Approach of Epidemics

From 1710 until 1870, French Canadian voyageurs plied the rivers of western Canada by canoe, trading with the indigenous peoples. Simultaneously, they unintentionally spread tuberculosis. But it was not until the fur traders had ceased their visits in the late 1800s that epidemics began to break out. (Credit: Drawing originally from Cartouche from William Faden)

ScienceDaily (Apr. 11, 2011) — Patience may be a virtue in a person, but in an infectious disease, it is insidious. Witness tuberculosis, which can lie dormant in a human host for decades before bursting forth into infection. TB's stealthy nature has made it difficult to decipher how it spreads, seriously hampering efforts to control it. The World Health Organization estimates that a third of the people on Earth are infected.

Now, a study led by Stanford scientists has provided new insights into the behavior of tuberculosis by tracing the travels of a particular strain of the disease that was unintentionally spread among the indigenous peoples of western Canada by French Canadian voyageurs during the fur trade era. Although the disease was probably brought into the native populations repeatedly from about 1710 to 1870, it didn't spark an epidemic until the fur trade had largely ended, more than 150 years from when it was first introduced.

"We found there was this widespread, low-level dispersal of tuberculosis that did not become obvious until environmental changes occurred that created conditions conducive to epidemics," said Caitlin Pepperell, an infectious diseases specialist at Stanford.

The process, she said, resembles the way a smoldering fire can spread underground, through the roots of trees and brush, then burst into fire without warning.

"Tuberculosis epidemics are the outcomes of a process that has effectively been occurring underground," she said -- unlike smallpox, which quickly escalates into epidemics.

"This helps explain why it has been so extraordinarily difficult to eradicate TB."

The conditions that finally triggered epidemics in Canada in the late 1800s likely resulted from the relocation of native peoples onto reservations, where health conditions were often abysmal.

Epidemic linked to malnutrition

The biggest factor, she said, was probably malnutrition. The buffalo, once a dietary mainstay of indigenous peoples on the prairie, had been virtually exterminated by then. Other principal food sources, such as other animals, wild plants and fish, were also severely depleted and attempts to provide famine relief fell woefully short.

Housing was also of low quality, with too many people living in close quarters, often lacking adequate ventilation or protection against the elements.

"With tuberculosis, even such simple things as having windows that open can actually make quite a large difference in terms of the risk of transmission," Pepperell said. "Any situation where there is poor ventilation, it is dark and it is crowded is perfect for transmitting TB."

Pepperell, a physician and an instructor in the division of infectious diseases at Stanford's School of Medicine, is the lead author of a paper about the study published online by *Proceedings of the National Academy of Sciences.*

"Up to now, it has been relatively hard to define the locations of origin of a strain of tuberculosis more precisely than a continent," said Marcus Feldman, professor of biology and a co-author of the paper. By looking at large numbers of bacterial samples and integrating genetic analysis with the work of fur trade historians, the researchers gained insight into how this particular strain must have spread.

They worked with archived *M. tuberculosis* bacterial samples from indigenous communities across Alberta, Saskatchewan and Ontario that had been previously collected by provincial health authorities. All the analyses were done on bacteria, not people. The scientists found a single strain of tuberculosis, characterized by a specific mutation, dominated in every community.

Earlier research had established that the same strain was also dominant among French Canadian residents of Quebec.

Strains traced to Quebec

"The tuberculosis strains from Quebec are missing a specific piece of DNA; that's how you can track them back to Quebec," Feldman said.

Tuberculosis can only be transmitted by someone with an active infection who is in close contact with others. The only time when French Canadians and the native peoples of Canada had substantial contact of that kind was during the fur trade era, so that had to be when the strain spread from the traders to the natives, Feldman and Pepperell said.

It was common during that era for traders to live in close contact with the native peoples, sometimes for months or years at a time. Enough of them formed close relationships that their unions gave rise to the people known as the Métis, who are of mixed indigenous and French Canadian ancestry.

"There were handfuls of cases of TB stretched out over this long time period, where clearly TB was being transmitted, but the number of cases was such that it was not obvious to anyone at the time," Pepperell said.

"TB, from what we can tell, was just kind of rumbling along at this very low level and probably would have continued that way, or even petered out completely, if it wasn't for the deplorable living conditions on the reserves," she said.

But by 1870 the era of the fur trade in its traditional, canoe-based form was over. There was no longer any need for the voyageurs, as furs were now transported by train. Most of the indigenous tribes had been relocated to reservations, and forays by French Canadians largely ceased.

At the same time, the influx of settlers to western Canada skyrocketed. The population of western Canada grew from 110,000 in 1871 to 750,000 in 1911.

Based on another researcher's analysis of original documents from the Hudson's Bay Company and other primary sources, Pepperell and Feldman estimate that only about 5,500 voyageurs had penetrated what was then the western wilderness during the entire 160-year span of the fur trade.

In spite of the huge numbers of immigrants after 1870 from regions in Europe, America and East Asia with high incidences of TB, these more recently arrived strains made scant inroads into the native population. That lack of transmission was likely due to a lack of social interaction between the settlers and the natives, and preserved the dominance of the French Canadian strain.

Pepperell and Feldman said it is too early to tell how applicable the results of their study will be in other settings, as not enough is known about the factors affecting tuberculosis migration in general.

"This approach of looking at the genetics in concert with epidemiology is fairly new in the world of bacterial research," Pepperell said. "I would say in terms of the overall research on TB, it is a little bit like the organism itself.

"TB research has had a very long latent period, and now we are kind of getting into an expansion phase, which is a really good thing."

The research was supported by the National Institutes of Health.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Stanford University**. The original article was written by Louis Bergeron.

Journal Reference:

1. C. S. Pepperell, J. M. Granka, D. C. Alexander, M. A. Behr, L. Chui, J. Gordon, J. L. Guthrie, F. B. Jamieson, D. Langlois-Klassen, R. Long, D. Nguyen, W. Wobeser, M. W. Feldman. **Dispersal of Mycobacterium tuberculosis via the Canadian fur trade**. *Proceedings of the National Academy of Sciences*, 2011; DOI: 10.1073/pnas.1016708108

http://www.sciencedaily.com/releases/2011/04/110411131350.htm

Tourism Does Not Harm All Caves, Study Suggests

Despite the high number of tourists, the large size of the cave means the thermal signal disperses very quickly and gently. (Credit: David Domínguez Villar et al.)

ScienceDaily (Apr. 11, 2011) — Unlike the situation in other caves, damage caused by tourists at the Águila cave in Ávila, Spain is "imperceptible," despite it receiving tens of thousands of visitors each year. This is the main conclusion of an international research study headed by the University of Alcalá (UAH), which measured heat variations in the cave.

"Despite the tens of thousands of visitors that the Águila Cave receives each year, the temperature variations in it are related to the weather outside, while the long-term impact of tourism is virtually non-existent," David Domínguez Villar, researcher at the Department of Geology of the UAH and lead author of the study published in the journal *Acta Carsologica*, said.

The research was carried out using data gathered by temperature sensors, which have been fitted in the cave since 2008. These devices make it possible to observe heat variations in the cave, and are very sensitive to the impact of visitors.

"We took data from the cave every 10 minutes and used a filter. The impact of visitor arrivals on temperature increase could be observed immediately. For this reason, we chose the maximum and minimum levels, and we filtered certain periods with or without visitors so that we could differentiate between the natural dynamics of the cave and the impact of the visitors," says Domínguez.

Despite the high number of tourists, the large size of the cave means the thermal signal disperses very quickly and gently. "This is the opposite of what happens in other caves, such as Altamira, which have a gallery shape, meaning that just a few people have an immense impact," the expert explains.

The average temperature of the cave was 15.6ºC in 2009, and tourist visits caused thermal anomalies of less than 0.15ºC, with the temperature generally returning to normal overnight.

On days with higher numbers of visitors, the effects of the thermal anomalies lasted "from one day to the next," and caused temperature increases in the cave for longer periods of time. However, this humanmade effect disappeared shortly after the number of tourists fell. In most cases the effect lasted for less than a week.

According to the scientists, the biggest problem in caves with wall paintings is corrosion caused by condensation. "The walls of the Águila cave are also corroded, although it does not have paintings. However, this degradation is due to natural effects. In addition, no condensation-related corrosion can be seen on the stalagmites that are currently growing," Domínguez adds.

Studying a region's climate on the basis of a cave

The researchers also intend to study the past climate by using the stalagmites in the cave. "We want to look at how the external and internal temperature is recorded, and see the temperature trends and changes inside the cave," the researcher adds.

Currently, a certain degree of seasonal change can be seen in the cave, but heat dispersion via rock is much slower than in the air. In fact, the experts say that the thermal signal from outside takes around seven years to reach the inside.

"The temperature records of the cave could be related to the climate of the region, and could be used to reconstruct the temperature of this area, aside from the impact of visitors," he concludes.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **FECYT - Spanish Foundation for Science and Technology**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. David Dominguez-Villar, Ian J. Fairchild, Rosa M. Carrasco, Javier Pedraza, Andy Baker. **The effect of visitors in a touristic cave and the resulting constraints on natural thermal conditions for palaeoclimate studies (eagle cave, central Spain)**. *Acta Carsologica*, 39 (3): 491-502, 2010 [link]

http://www.sciencedaily.com/releases/2011/04/110411111036.htm

Artificial Intelligence for Improving Data Processing

Artificial Intelligence offers many possibilities for developing data processing systems which are more precise and robust. (Credit: UMC3)

ScienceDaily (Apr. 11, 2011) — Artificial Intelligence offers many possibilities for developing data processing systems which are more precise and robust. That is one of the main conclusions drawn from an international encounter of experts in this scientific area, recently held at Universidad Carlos III de Madrid (UC3M).

Within this framework, five leading scientists presented the latest advances in their research work on different aspects of AI. The speakers tackled issues ranging from the more theoretical such as algorithms capable of solving combinatorial problems to robots that can reason about emotions, systems that use vision to monitor activities, and automated players that learn how to win in a given situation. "Inviting speakers from groups of references allows us to offer a panoramic view of the main problems and the techniques open in the area, including advances in video and multi-sensor systems, task planning, automated learning, games, and artificial consciousness or reasoning," the experts noted.

The participants from the AVIRES (The Artificial Vision and Real Time Systems) research group at the University of Udine gave a seminar on the introduction of data fusion techniques and distributed artificial vision. In particular, they dealt with automated surveillance systems with visual sensor networks, from basic techniques for image processing and object recognition to Bayesian reasoning for understanding activities and automated learning and data fusion to make high performance system. Dr.Simon Lucas, professor at the Essex University and editor in chief of IEEE Transactions on Computational Intelligence and AI in Games and a researcher focusing on the application of AI techniques on games, presented the latest trends in generation algorithms for game strategies. During his presentation, he pointed out the strength of UC3M in this area, citing its victory in two of the competitions held at the international level during the most recent edition of the Conference on Computational Intelligence and Games.

In addition, Enrico Giunchiglia, professor at the University of Genoa and former president of the Council of the International Conference on Automated Planning and Scheduling (ICAPS), described the most recent work in the area of logic satisfaction, which is rapidly growing due to its applications in circuit design and in task planning

Artificial Intelligence (IA) is as old as computer science and has generated ideas, techniques and applications that permit it to solve difficult problems. The field is very active and offers solutions to very diverse sectors. The number of industrial applications that have an AI technique is very high, and from the scientific point of view, there are many specialized journals and congresses. Furthermore, new lines of research are constantly being open and there is a still great room for improvement in knowledge transfer between researchers and industry. These are some of the main ideas gathered at the 4th International Seminar on New Issues on Artificial Intelligence), organized by the SCALAB group in the UC3M Computer Engineering Department at the Leganés campus of this Madrid university.

The future of Artificial Intelligence

This seminar also included a talk on the promising future of AI. "The tremendous surge in the number of devices capable of capturing and processing information, together with the growth of the computing capacity and the advances in algorithms enormously boost the possibilities for practical application," the researchers from the SCALAB group pointed out. Among them we can cite the construction of computer programs that make life easier, which take decisions in complex environments or which allow problems to be solved in environments which are difficult to access for people," he noted. From the point of view of these research trends, more and more emphasis is being placed on developing systems capable of learning and demonstrating intelligent behavior without being tied to replicating a human model.

AI will allow advances in the development of systems capable of automatically understanding a situation and its context with the use of sensor data and information systems as well as establishing plans of action, from support applications to decision making within dynamic situations. According to the researchers, this is due to the rapid advances and the availability of sensor technology which provides a continuous flow of data about the environment, information that must be dealt with appropriately in a node of data fusion and information. Likewise, the development of sophisticated techniques for task planning allow plans of action to be composed, executed, checked for correct execution, and rectified in case of some failure, and finally to learn from mistakes made.

This technology has allowed a wide range of applications such as integrated systems for surveillance, monitoring and detecting anomalies, activity recognition, teleassistence systems, transport logistic planning, etc. According to Antonio Chella, Full Professor at the University of Palermo and expert in Artificial Consciousness, the future of AI will imply discovering a new meaning of the word "intelligence." Until now, it has been equated with automated reasoning in software systems, but in the future AI will tackle more daring concepts such as the incarnation of intelligence in robots, as well as emotions, and above all consciousness.

story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Universidad Carlos III de Madrid - Oficina de Información Científica**.

http://www.sciencedaily.com/releases/2011/04/110411083750.htm

Complex Composite Materials: Replacement Found for Rare Material Indium Tin Oxide

4-point conductivity measurement of the new transparent conducting film developed by prof. Cor Koning (left) and prof. Paul van der Schoot (right). The black pot contains a dispersion of carbon nanotubes in water, and the white pot contains the conducting latex. (Credit: Bart van Overbeeke)

ScienceDaily (Apr. 11, 2011) — Researchers at Eindhoven University of Technology (TU/e, Netherlands) have developed a replacement for indium tin oxide (ITO), an important material used in displays for all kinds of everyday products such as TVs, telephones and laptops, as well as in solar cells. Unfortunately indium is a rare metal, and the available supplies are expected to be virtually exhausted within as little as ten years. The replacement material is a transparent, conducting film produced in water, and based on electrically conducting carbon nanotubes and plastic nanoparticles. It is made of commonly available materials, and on top of that is also environment-friendly.

The results, which also provide new insights into conduction in complex composite materials, were published online April 10 in the scientific journal *Nature Nanotechnology.*

The research team has been able to achieve higher conductivity by combining low concentrations of carbon nanotubes and conducting latex in a low-cost polystyrene film. The nanotubes and the latex together account for less than 1 percent of the weight of the conducting film. That is important, because a high concentration of carbon nanotubes makes the film black and opaque, so the concentration needs to be kept as low as possible. The research team was led by theoretical physicist Paul van der Schoot and polymer chemist Cor Koning. Post-doc Andriy Kyrylyuk is the first author of the paper in *Nature Nanotechnology.*

The researchers use standard, widely available nanotubes which they then dissolve in water. Then they add conducting latex (a solution of polymer beads in water), together with a binder in the form of polystyrene beads. When the mixture is heated, the polystyrene beads fuse together to form the film, which contains a conducting network of nanotubes and beads from the conducting latex. The water, which only serves as a dispersing agent in production, is removed by freeze-drying. The 'formula' is not a question of good luck, as the researchers first calculated the expected effects and also understand how the increased conductivity works.

The conductivity of the transparent e-film is still a factor 100 lower than that of indium tin oxide. But Van der Schoot and Koning expect that the gap can quickly be closed. "We used standard carbon nanotubes, a mixture of metallic conducting and semiconducting tubes," says Cor Koning. "But as soon as you start to use 100 percent metallic tubes, the conductivity increases greatly. The production technology for 100 percent metallic tubes has just been developed, and we expect the price to fall rapidly." However the conductivity of the film

is already good enough to be used immediately as an antistatic layer for displays, or for EMI shielding to protect devices and their surroundings against electromagnetic radiation.
The film has an important advantage over ITO: it is environment-friendly. All the materials are water based, and no heavy metals such as tin are used. The new film is also a good material for flexible displays.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Eindhoven University of Technology**.

Journal Reference:

1. Andriy V. Kyrylyuk, Marie Claire Hermant, Tanja Schilling, Bert Klumperman, Cor E. Koning, Paul van der Schoot. **Controlling electrical percolation in multicomponent carbon nanotube dispersions**. *Nature Nanotechnology*, 2011; DOI: 10.1038/NNANO.2011.40

http://www.sciencedaily.com/releases/2011/04/110411083748.htm

Bacterial Genome May Hold Answers to Mercury Mystery

bacterium called Desulfovibrio desulfuricans strain ND132 can transform elemental mercury into methylmercury, a human neurotoxin. (Credit: Image courtesy of DOE/Oak Ridge National Laboratory)

ScienceDaily (Apr. 10, 2011) — A newly sequenced bacterial genome from a team led by the Department of Energy's Oak Ridge National Laboratory could contain clues as to how microorganisms produce a highly toxic form of mercury.

Methylmercury, a potent human neurotoxin, appears in the environment when certain naturally occurring bacteria transform inorganic mercury into its more toxic cousin. Few bacterial species are capable of this conversion, and exactly how the transformation takes place has been a matter of debate for decades.

"What is not known are the genes or the proteins that allow these bacteria to mediate the transformation," said ORNL's Steven Brown, who led a research team to sequence the genome of a bacterium in the Desulfovibrio genus that is capable of methylating mercury.

The new genome, sequenced at the California-based DOE Joint Genome Institute (JGI) and published in the *Journal of Bacteriology*, lays the foundation for future research to examine the little understood mechanisms behind the production of methylmercury.

Desulfovibrio desulfuricans strain ND132 is an organism that thrives in sediments and soils without oxygen -- the places in lakes, streams and wetlands where mercury contamination is converted to methylmercury. It is representative of a group of organisms that "breathe" sulfate instead of oxygen and are largely responsible for mercury methylation in nature. "This is the first Desulfovibrio genome that will methylate mercury that's been published," Brown said. "Now that we have this resource, we can take a comparative approach and look at what is different between the bacteria that can methylate mercury and those that are unable to."

The introduction of mercury into the environment primarily stems from its use in industrial processes and from the burning of fossil fuels. Although industry and regulators have worked to minimize the release of mercury, there is a legacy of mercury pollution in aquatic environments worldwide. Understanding the fundamental science behind the production of methylmercury could eventually help mitigate and reduce the impacts of mercury pollution.

"Mercury is a global contaminant of concern," Brown said. "We hope that some of the lessons we learn from these studies will be applicable to many sites. If we can identify the genes involved in mercury methylation, we hope to go to the local environment and understand more about the function and the ecology of the organisms and their gene products that mediate this transformation."
Collaborators included researchers from ORNL, the Smithsonian Environmental Research Center, the University of Missouri and Lawrence Berkeley National Laboratory's JGI.
The research was supported by DOE's Office of Science.
ORNL is managed by UT-Battelle for the Department of Energy's Office of Science.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **DOE/Oak Ridge National Laboratory**.

Journal Reference:

1. S. D. Brown, C. C. Gilmour, A. M. Kucken, J. D. Wall, D. A. Elias, M. Podar, O. Chertkov, B. Held, D. C. Bruce, J. C. Detter, R. Tapia, C. S. Han, L. A. Goodwin, J.-F. Cheng, S. Pitluck, T. Woyke, N. Mikhailova, N. N. Ivanova, J. Han, S. Lucas, A. L. Lapidus, M. L. Land, L. J. Hauser, A. V. Palumbo. **Genome Sequence of Mercury-Methylating Desulfovibrio desulfuricans ND132**. *Journal of Bacteriology*, 2011; DOI: 10.1128/JB.00170-11

http://www.sciencedaily.com/releases/2011/04/110408163915.htm

New Insights Into Predator/Prey Relationships

Researchers working. New research demonstrated that grasshopper behavior changed with the threat of predators, reducing grasshopper feeding, and this was apparent at all grasshopper densities. (Credit: Image courtesy of University of Notre Dame)

ScienceDaily (Apr. 10, 2011) — For those old enough to remember Mutual of Omaha's "Wild Kingdom" television series, the dynamics of predator-prey relationships seemed clear enough: predators thinned out prey populations, which enabled a smaller, but stronger, population to survive and reproduce.

However, a new paper by University of Notre Dame biologist Gary Belovsky appearing in the journal *Ecology Letters* suggests that predator-prey relationships are much more complex than originally thought.

The paper arose out of pioneering studies Belovsky, who also is director of the Notre Dame Environmental Research Center (UNDERC), has been conducting on grasshopper populations since 1978 at Montana's National Bison Range, now a location for one of UNDERC's national undergraduate programs.

Belovsky conducted an experiment to examine how behavioral responses of grasshoppers to avian predators affected grasshopper survival and reproduction at different grasshopper population densities. A series of cages containing grasshoppers were enclosed within a tent constructed of aviary netting, creating a "no threat" area because its design prevented birds from approaching the cages and "scarring" the grasshoppers. A second set of cages provided a "threat" area because it was not enclosed in a tent, which allowed birds to feed around the cages, perch on top consuming grasshoppers caught outside the cages and "scare" the grasshoppers inside the cages.

The research demonstrated that grasshopper behavior changed with the threat of predators, reducing grasshopper feeding, and this was apparent at all grasshopper densities. The behavioral changes with the threat of predation increased survival at low grasshopper densities, as reduced feeding made food available to more individuals, while the changes decreased survival at higher densities, as severe food shortages were made worse by reduced feeding. However, the behavioral changes decreased per capita reproduction over all grasshopper population densities, as grasshoppers traded off survival and reproduction as competition among the grasshoppers increased with greater population densities.

This type of variable response is generally overlooked when prey behavioral changes with predation are considered in how predation affects prey populations," Belovsky said. "Resource availability may need to be considered when assessing how prey behavioral changes with predation threat affect population and food web dynamics."

Belovsky also notes that the new paper reinforces the importance of his western prairie research, which is now the longest running experimental study at a site examining what controls grasshopper populations. Although it isn't feasible to conduct a population study like this with populations of larger animals, such as elk and wolves in far-flung areas such as Alaska, the more easily observable field work with grasshoppers and birds offers important predator-prey insights that can be applied to these types of populations.

Story Source:

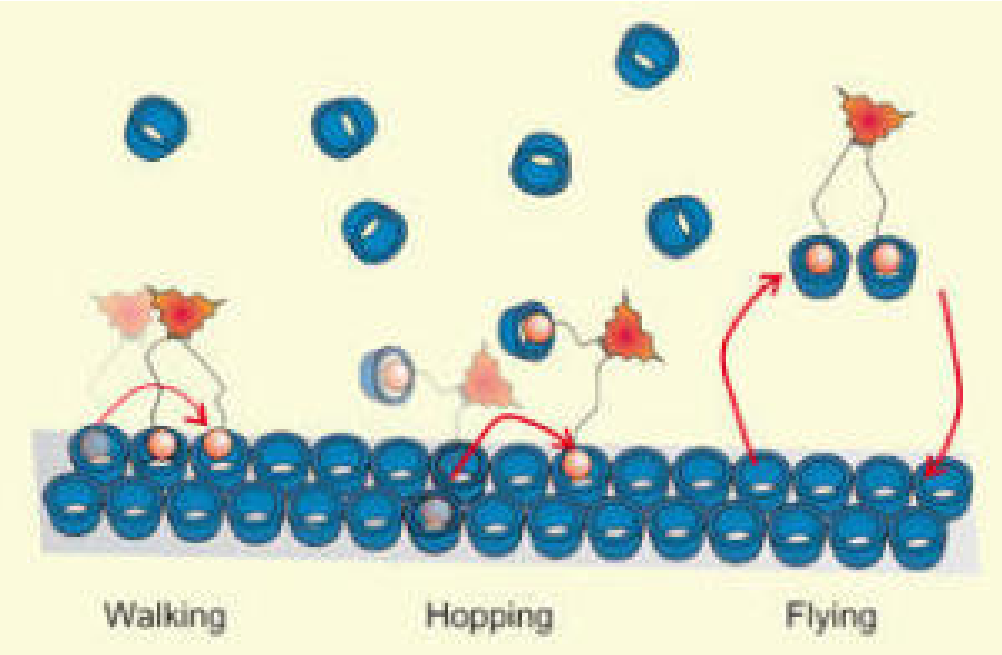
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Notre Dame**.

Journal Reference:

1. Gary E. Belovsky, Angela Nardoni Laws, Jennifer B. Slade. **Prey change behaviour with predation threat, but demographic effects vary with prey density: experiments with grasshoppers and birds**. *Ecology Letters*, 2011; 14 (4): 335 DOI: 10.1111/j.1461-0248.2011.01591.x

http://www.sciencedaily.com/releases/2011/04/110408114358.htm

Are We Only a Hop, Skip and Jump Away from Controlled Molecular Motion?



The mechanism of molecular motion changes as the environment changes; in this case, due to competition from free receptors (blue) in solution. (Credit: © Nature Chemistry. A. Perl, A.)

ScienceDaily (Apr. 10, 2011) — Scientists may very well be a hop, skip and jump away from controlled molecular motion, according to a study in this month's *Nature Chemistry*.

Controlling how molecules move on surfaces could be the key to more potent drugs that block the attachment of viruses to cells, and will also speed development of new materials for electronics and energy applications. The study is the culmination of a EU-funded collaboration between Tyndall National Institute, UCC researcher Dr. Damien Thompson and colleagues at University of Twente in the Netherlands. Dr. Thompson performed computer simulations that enabled a greater understanding of how two-legged molecules move along patterned surfaces, in a kind of molecular hopscotch.

Widespread industrial uptake of nanotechnology requires cheap, easy and robust solutions that allow manipulation of matter at the smallest scales and so a key enabling feature will be the ability to move material around molecule by molecule. One of the major difficulties is the very different physics that operates at the scale of atoms and molecules; water, for example, feels more like treacle to a molecule, and molecules tend to huddle and stick together due to microscopic forces between their atoms. Dr. Thompson explains: "The experiments performed by the group at Twente were very elegant. They involved making two-legged molecules and using a fluorescence microscope to watch how they move along a wet surface. The molecules are hydrophobic, meaning they don't like water, and the surface was pockmarked with hydrophobic cavities so a weak glueing interaction, based on a mutual dislike of water, drives the interaction between the molecules and the surface.

While the energetics of this type of interaction was worked out over a decade ago by George Whitesides's group at Harvard, it's usefulness for materials development was limited because little was known until now on the paths that the molecules take."

Because the molecules have multiple legs, they display a surprisingly rich behaviour at the surface, beyond simply attaching/detaching, with Dr. Thompson's computer simulations complementing the experiments and showing the different mechanisms by which the molecules move. The motion switches from walking to hopping to flying, as the environment changes.

Dr. Thompson continues: "Access to high performance computing facilities enabled us to model the different pathways and aid interpretation of the microscopy results. We ran most of the simulations on our own Science Foundation Ireland-supported computing clusters at Tyndall, and also did a few larger-scale calculations at

the Irish Center for High End Computing. It's an exciting time for research as experiments and simulations are finally on the same page; the experiments can finally drill down far enough to see molecule-scale features while advances in computing mean we can routinely model systems composed of hundreds of thousands, and even millions, of atoms."

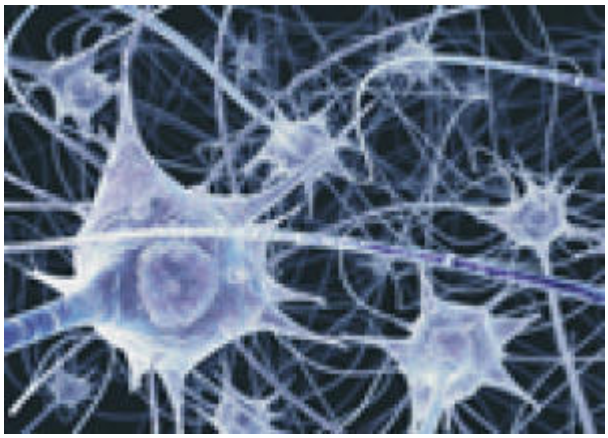
Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Tyndall National Institute**, via AlphaGalileo.

Journal Reference:

1. András Perl, Alberto Gomez-Casado, Damien Thompson, Henk H. Dam, Pascal Jonkheijm, David N. Reinhoudt, Jurriaan Huskens. **Gradient-driven motion of multivalent ligand molecules along a surface functionalized with multiple receptors**. *Nature Chemistry*, 2011; 3 (4): 317 DOI: 10.1038/nchem.1005

http://www.sciencedaily.com/releases/2011/04/110408163443.htm

Mapping the Brain: New Technique Poised to Untangle the Complexity of the Brain



An illustration of a network of nerve cells in the brain. (Credit: Benedict Campbell, Wellcome Images.)

ScienceDaily (Apr. 10, 2011) — Scientists have moved a step closer to being able to develop a computer model of the brain after developing a technique to map both the connections and functions of nerve cells in the brain together for the first time.

A new area of research is emerging in the neuroscience known as 'connectomics'. With parallels to genomics, which maps the our genetic make-up, connectomics aims to map the brain's connections (known as 'synapses'). By mapping these connections -- and hence how information flows through the circuits of the brain -- scientists hope to understand how perceptions, sensations and thoughts are generated in the brain and how these functions go wrong in diseases such as Alzheimer's disease, schizophrenia and stroke.

Mapping the brain's connections is no trivial task, however: there are estimated to be one hundred billion nerve cells ('neurons') in the brain, each connected to thousands of other nerve cells -- making an estimated 150 trillion synapses. Dr Tom Mrsic-Flogel, a Wellcome Trust Research Career Development Fellow at UCL (University College London), has been leading a team of researchers trying to make sense of this complexity. "How do we figure out how the brain's neural circuitry works?" he asks. "We first need to understand the function of each neuron and find out to which other brain cells it connects. If we can find a way of mapping the connections between nerve cells of certain functions, we will then be in a position to begin developing a computer model to explain how the complex dynamics of neural networks generate thoughts, sensations and movements."

Nerve cells in different areas of the brain perform different functions. Dr Mrsic-Flogel and colleagues focus on the visual cortex, which processes information from the eye. For example, some neurons in this part of the brain specialise in detecting the edges in images; some will activate upon detection of a horizontal edge, others by a vertical edge. Higher up in visual hierarchy, some neurons respond to more complex visual features such as faces: lesions to this area of the brain can prevent people from being able to recognise faces, even though they can recognise individual features such as eyes and the nose, as was famously described in the book The Man Who Mistook Wife for a Hat by Oliver Sachs.

In a study published online April 10 in the journal *Nature*, the team at UCL describe a technique developed in mice which enables them to combine information about the function of neurons together with details of their synaptic connections.

The researchers looked into the visual cortex of the mouse brain, which contains thousands of neurons and millions of different connections. Using high resolution imaging, they were able to detect which of these neurons responded to a particular stimulus, for example a horizontal edge.

Taking a slice of the same tissue, the researchers then applied small currents to a subset of neurons in turn to see which other neurons responded -- and hence which of these were synaptically connected. By repeating this technique many times, the researchers were able to trace the function and connectivity of hundreds of nerve cells in visual cortex.

The study has resolved the debate about whether local connections between neurons are random -- in other words, whether nerve cells connect sporadically, independent of function -- or whether they are ordered, for

example constrained by the properties of the neuron in terms of how it responds to particular stimuli. The researchers showed that neurons which responded very similarly to visual stimuli, such as those which respond to edges of the same orientation, tend to connect to each other much more than those that prefer different orientations.

Using this technique, the researchers hope to begin generating a wiring diagram of a brain area with a particular behavioural function, such as the visual cortex. This knowledge is important for understanding the repertoire of computations carried out by neurons embedded in these highly complex circuits. The technique should also help reveal the functional circuit wiring of regions that underpin touch, hearing and movement.

"We are beginning to untangle the complexity of the brain," says Dr Mrsic-Flogel. "Once we understand the function and connectivity of nerve cells spanning different layers of the brain, we can begin to develop a computer simulation of how this remarkable organ works. But it will take many years of concerted efforts amongst scientists and massive computer processing power before it can be realised."

The research was supported by the Wellcome Trust, the European Research Council, the European Molecular Biology Organisation, the Medical Research Council, the Overseas Research Students Award Scheme and UCL.

"The brain is an immensely complex organ and understanding its inner workings is one of science's ultimate goals," says Dr John Williams, Head of Neuroscience and Mental Health at the Wellcome Trust. "This important study presents neuroscientists with one of the key tools that will help them begin to navigate and survey the landscape of the brain."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Wellcome Trust**.

Journal Reference:

1. Ho Ko, Sonja B. Hofer, Bruno Pichler, Katherine A. Buchanan, P. Jesper Sjöström, Thomas D. Mrsic-Flogel. **Functional specificity of local synaptic connections in neocortical networks**. *Nature*, 2011; DOI: 10.1038/nature09880

http://www.sciencedaily.com/releases/2011/04/110410181302.htm

Green Tea and Tai Chi Enhance Bone Health and Reduce Inflammation in Postmenopausal Women

Cup with green tea, with mint and lemon. (Credit: © NataliTerr / Fotolia)

ScienceDaily (Apr. 10, 2011) — C.S. Lewis, the famous author and Oxford academic, once proclaimed "You can't get a cup of tea big enough or a book long enough to suit me." We sip it with toast in the morning, enjoy it with sweets and biscuits in the afternoon, and relax with it at the end of the day. Tea has for generations been an integral infusion worldwide, carrying both epicurean and economic significance. But, does it impart honest-to-goodness health benefits? In other words, is its persistence in the human diet perhaps coincident with enhanced quality (or quantity) of life?

Dr. Chwan-Li (Leslie) Shen, an associate professor and a researcher at the Laura W. Bush Institute for Women's Health at the Texas Tech University Health Sciences Center, is convinced that the answer to this question is a resounding yes -- especially if the tea is of the "green" variety. Green tea, historically consumed in the Orient and now an international mainstay, is chock full of compounds called polyphenols known for their potent antioxidant activity. Dozens of epidemiological (observational) studies have shown that people who consume the highest levels of green tea polyphenols (GTP) tend to have lower risks of several chronic degenerative diseases such as cardiovascular disease and osteoporosis. These findings have been followed up with animal studies, including some conducted by Shen, suggesting that the mechanism behind this correlation may have to do with lowering chronic levels of inflammation.

Originally from Taiwan, Dr. Shen has now spent over 2 decades studying how and why some Eastern lifestyle norms (such as drinking green tea) might be beneficial for Westerners as well. For instance, she has developed an animal model (the ovariectomized, middle-aged female rat). With this model Dr. Shen and her team can effectively study the effects of green tea consumption on protection against breakdown of the bone's microarchitecture. In humans, this can lead to osteoporosis, a condition common to older women. It is Dr Shen's hope that what she learns from her animal models might also be applicable to postmenopausal women.

In Shen's most recent research, she focused on postmenopausal women and investigated the potential for green tea to work synergistically with tai chi -- a traditional Chinese form of moderately intense aerobic fitness activity grounded in mind-body philosophy -- in enhancing bone strength.

Carried out as a double-blind, placebo-controlled, intervention trial (the "holy grail" of scientific studies), this experiment involved 171 postmenopausal women (mean age: ~57 y) who had weak bones but not full-fledged osteoporosis.

Subjects were divided into 4 groups:

- Placebo: starch pill (placebo) and no tai chi
- GTP: green tea polyphenols (500 mg/day) and no tai chi
- Placebo+TC: starch pill and tai chi (3 times/week)
- GTP+TC: green tea polyphenols and tai chi

The study lasted for 6 months, during which time blood and urine samples were collected and muscle strength assessed.

The results show that consumption of GTP (at a level equivalent to about 4-6 cups of steeped green tea daily) and participation in tai chi independently enhanced markers of bone health by 3 and 6 months, respectively. A similar effect was found for muscle strength at the 6-month time point. Participants taking tai chi classes also reported significant beneficial effects in quality of life in terms of improving their emotional and mental health. Perhaps most remarkable, however, was the substantial effect that both GTP and tai chi had on biological markers of oxidative stress. Because oxidative stress is a main precursor to inflammation, this finding suggests that green tea and tai chi may help reduce the underlying etiology of not only osteoporosis, but other inflammatory diseases as well.

Dr. Shen and colleagues concluded that there is a "favorable effect of modest green tea consumption on bone remodeling in this pre-osteoporotic population" and hope to soon complete a more long-term study utilizing more technically savvy measures of bone density.

Perhaps C.S. Lewis was correct -- it's tea time!

The results of this work, which was funded by the National Institutes of Health/National Center for Complementary and Alternative Medicine, will be presented as a poster at the Experimental Biology meetings on April 10.

Dr. Chwan-Li Shen (Texas Tech University), Dr. Ming-Chien Chyu (Texas Tech University), Dr. James K. Yeh, Dr. Yan Zhang (Texas Tech University), Dr. Barbara Pence (Texas Tech University), Dr. Carol Felton (Texas Tech University), Dr. Jean-Michel Brismee (Texas Tech University), Mr. Raul Dagda (Texas Tech University), Mrs. Susan Doctolero (Texas Tech University), Mrs. Mary Flores (Texas Tech University), and Dr. Jai-Sheng Wang (University of Georgia) were coauthors on this paper.

Story Source:

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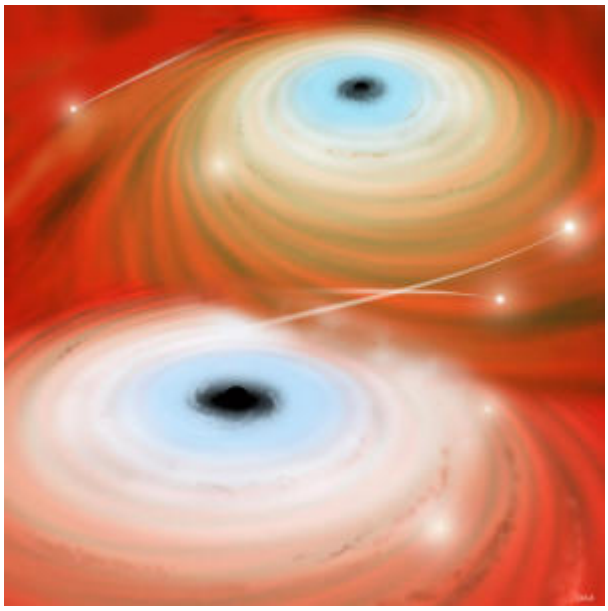
Newly Merged Black Hole Eagerly Shreds Stars



In this artist's conception, two black holes are about to merge. When they combine, gravitational wave radiation will "kick" the black hole like a rocket engine, sending it rampaging through nearby stars. (Credit: David A. Aguilar (CfA))

ScienceDaily (Apr. 9, 2011) — A galaxy's core is a busy place, crowded with stars swarming around an enormous black hole. When galaxies collide, it gets even messier as the two black holes spiral toward each other, merging to make an even bigger gravitational monster.

Once it is created, the monster goes on a rampage. The merger kicks the black hole into surrounding stars. There it finds a hearty meal, shredding and swallowing stars at a rapid clip. According to new research by Nick Stone and Avi Loeb (Harvard-Smithsonian Center for Astrophysics), upcoming sky surveys might offer astronomers a way to catch a gorging black hole "in the act."

Before the merger, as the two black holes whirl around each other, they stir the galactic center like the blade of a blender. Their strong gravity warps space, sending out ripples known as gravitational waves. When the black holes merge, they emit gravitational waves more strongly in one direction. That inequality kicks the black hole in the opposite direction like a rocket engine.

"That kick is very important. It can shove the black hole toward stars that otherwise would have been at a safe distance," said Stone.

"Essentially, the black hole can go from starving to enjoying an all-you-can-eat buffet," he added.

When tidal forces rip a star apart, its remains will spiral around the black hole, smashing and rubbing together, heating up enough to shine in the ultraviolet or X-rays. The black hole will glow as brightly as an exploding star, or supernova, before gradually fading in a distinctive way.

Importantly, a wandering, supermassive black hole is expected to swallow many more stars than a black hole in an undisrupted galactic center. A stationary black hole disrupts one star every 100,000 years. In the best-case scenario, a wandering black hole could disrupt a star every decade. This would give astronomers a much better opportunity of spotting these events, particularly with new survey facilities like Pan-STARRS and the Large Synoptic Survey Telescope.

Catching the signal from a disrupted star is a good start. However, astronomers really want to combine that information with gravitational wave data from the black hole merger. The Laser Interferometer Space Antenna (LISA), a future mission designed to detect and study gravitational waves, could provide that data. Gravitational wave measurements yield very accurate distances (to better than one part in a hundred, or 1 percent). However, they don't provide precise sky coordinates. A star's tidal disruption will let astronomers pinpoint the galaxy containing the recently merged black-hole binary.

By correlating the galaxy's redshift (a change in its light that's caused by the expanding universe) with an accurate distance, astronomers can infer the equation of state of dark energy. In other words, they can learn more about the force that's accelerating cosmic expansion, and which dominates the cosmic mass/energy budget today.
"Instead of 'standard candles' like supernovae, the black hole binary would be a 'standard siren.' Using it, we could create the most accurate cosmic 'ruler' possible," stated Loeb.
Finding a merged black hole also would allow theorists to explore a new regime of Einstein's general theory of relativity.
"We could test general relativity in the regime of strong gravity with unprecedented precision," said Loeb.
Their work was published in the March 2011 issue of *Monthly Notices of the Royal Astronomical Society*.
Headquartered in Cambridge, Mass., the Harvard-Smithsonian Center for Astrophysics (CfA) is a joint collaboration between the Smithsonian Astrophysical Observatory and the Harvard College Observatory. CfA scientists, organized into six research divisions, study the origin, evolution and ultimate fate of the universe.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Harvard-Smithsonian Center for Astrophysics**.

Journal Reference:

1. Nicholas Stone, Abraham Loeb. **Prompt tidal disruption of stars as an electromagnetic signature of supermassive black hole coalescence**. *Monthly Notices of the Royal Astronomical Society*, 2011; 412 (1): 75 DOI: 10.1111/j.1365-2966.2010.17880.x

http://www.sciencedaily.com/releases/2011/04/110408124301.htm

New Genetic Technique Probes the Cause of Skin Cell Differentiation in Mammals

Thin-skinned. Researchers infected mouse embryos with a virus (left, red) which, through RNA interference, blocked the activity of key genes involved in skin cell differentiation and stratification. The result was that the skin failed to develop and thicken properly, allowing it to soak up a blue dye (right) that normal skin would exclude. (Credit: Image courtesy of Rockefeller University)

ScienceDaily (Apr. 9, 2011) — A tremendous amount of genetics research has been done in flies and tiny worms, in part because scientists have good tools for tweaking these creatures' DNA. Now, by adapting a powerful method of RNA interference for use in mice, researchers have identified key pathways that cause skin cells to differentiate, eventually forming the flexible but protective outer casing of the body.

The work, published February 17 by *Nature*, illustrates the potential for performing relatively fast and complex genetic studies in a fellow mammal, and also provides a deeper understanding of cell differentiation in early development.

Led by Scott Williams, a postdoctoral fellow in Elaine Fuchs' Laboratory of Mammalian Cell Biology and Development, the researchers targeted the genes in a pathway for skin cell differentiation that had not been previously probed in vertebrates. Deploying a technique co-developed by Slobodan Beronja and Geulah Livshits in Fuch's lab and published last July in *Nature Medicine*, the scientists used RNA interference to systematically block the function of genes in developing mouse embryos. Williams and his colleagues in the lab were interested in the chain of events that leads to asymmetric cell division, a common developmental phenomenon by which stem cells balance self-renewal and differentiation, allowing them to generate the diversity of cell-types that create the panoply of an adult organism's tissues and organs.

Prior research in Fuchs' lab, published by *Nature* in 2005, showed that in early development skin begins as a single layer of symmetrically dividing epidermal progenitor cells. But at a certain point, cells begin dividing asymmetrically, or perpendicular to that layer. In asymmetric division, one daughter cell stays in the original layer, self-renews and maintains its progenitor potential; the overlying daughter cell differentiates in a process of stratification that produces an effective barrier. "As more asymmetric divisions occur, multiple layers of terminally differentiating cells are produced, so that by the time the mouse is born, its epidermis displays a self-renewing, protective skin barrier to keep harmful microbes out and bodily fluids in," says Fuchs, who is also a Howard Hughes Medical Institute investigator.

These findings pointed the way to the latest research. Drawing on previous experiments that identified genes involved in asymmetric cell division in the developing neurons of fruit flies, the Fuchs team targeted a pathway involving the mouse versions of these genes: LGN, NuMA and Dctn1. They used a method of RNA interference which is based on the fact that short pieces of RNA, called small hairpin RNAs, can destroy RNA messages from specific genes, thereby preventing the genes from producing proteins. The researchers loaded a virus with short RNA bits that target the genes of interest, and guided by ultrasound, they injected the virus into the amniotic fluid surrounding the embryos in a pregnant mouse. The virus infected the outermost layer of the embryos, which shortly after gastrulation, is the single-layered skin. This effectively silenced the genes they were targeting at precisely the right time and blocked asymmetric cell divisions. The result was that the infected mice's skin failed to develop properly, in large part because there were now too few differentiating layers to provide a good skin barrier.

Looking more closely, the scientists also found that silencing the asymmetric cell division genes LGN, NuMA and Dctn1 effectively halted signaling by a molecule, Notch, which is known to regulate differentiation in many types of cells, including skin. When they added Notch signaling back into the genetically modified embryos, the skin developed normally, providing strong evidence that Notch is a key player in the normal differentiation of skin cells.

"This technique allows us to do the kind of precise experiments that have been done in worms and flies in the much more complex system of the mouse," Williams says. "And we can do them fast, going from gene to function in about two months."

Existing methods for creating mice that lack certain genes -- "knockout" mice -- sometimes take years of intensive breeding. Fuchs' laboratory plans to use the new technique to examine in increasing detail the molecular pathways that govern the healthy differentiation and development of skin. The findings could help explain the possible role of stem cells in cancer, an area of research that is heating up.

"Cells that acquire characteristics of self-renewing stem cells but fail to respond to growth inhibitory signals from their environment are likely at the root of cancers," Fuchs says. "It will be interesting in the future to see whether mutations in the pathways that govern asymmetric cell division might be responsible."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Rockefeller University**.

Journal Reference:

1. Scott E. Williams, Slobodan Beronja, H. Amalia Pasolli, Elaine Fuchs. **Asymmetric cell divisions promote Notch-dependent epidermal differentiation**. *Nature*, 2011; 470 (7334): 353 DOI: 10.1038/nature09793

http://www.sciencedaily.com/releases/2011/04/110407202212.htm

Fighting Malaria With African Plant Extracts

Various herbal medicines are used to combat malaria. In Uganda, Torunn Stangeland and her colleagues collected plants to analyze. (Credit: Photo by Hans Overgaard)

ScienceDaily (Apr. 9, 2011) — Plants used in traditional African medicine may have an effect on the malaria parasite as well as the mosquitoes that spread the disease. A Norwegian pilot project is now indexing and testing these plants.

The malaria parasite has gradually developed resistance to the most commonly used medicines. To make matters worse, several mosquito species that host and transmit the parasite have become resistant to insecticides, making it difficult to eliminate them from populated areas.

Now researchers at the Norwegian University of Life Sciences (UMB) in Ås, south of Oslo, are studying and testing plant extracts that have been used in traditional African medicine to fight malaria. Ultimately, the researchers hope to find supplements and replacements for today's conventional medicines.

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Malaria is caused by the parasite *Plasmodium falciparum*, which is transmitted to its human hosts via various mosquito species of the genus *Anopheles*. The disease can cause fever high enough to be fatal. In tropical and subtropical regions such as sub-Saharan Africa, malaria remains a major cause of illness and death as well as a contributing factor to poverty.

Each year, 300 million people contract malaria. And each year, the disease kills one million of them -- mostly children under five years of age. Pregnant women are also highly vulnerable.

New solutions to thwart resistance

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The pilot project "Malaria control using plant extracts" has been granted funding under the Research Council's National Programme for Research in Functional Genomics in Norway (FUGE).

Effects and side effects

"There are several plants that have been shown to kill the malaria parasite," explains Researcher Torunn Stangeland of UMB. "Other plants are toxic to malaria-transmitting mosquitoes and could perhaps be utilised as insecticides." She and her colleague Hans Overgaard head the project.

The plants in question have never been scientifically tested for efficacy. Another unknown factor is whether they cause detrimental side effects for humans.

Early results promising

The Norwegian researchers have begun by testing the effectiveness of selected plant extracts against the parasite and mosquitoes. Next they will check for potential toxins to make sure the plants are safe to use. So far the trials look promising, but the results will not be finalised for some time.

The researchers will also investigate if there are synergistic effects of different compounds in the plant extracts. It may be more difficult for the malaria parasite and mosquitoes to develop resistance to the

medicines or insecticides if the entire plant is used, because of the many different chemical components that are present in varying concentrations.
"The fact that both the sweet wormwood plant (*Artemisia annua*) and the bark of the cinchona tree have been used for centuries against malaria -- and the parasite has yet to become resistant -- indicates some support for this theory," says Dr Stangeland.

Medicines owned and produced by Africa?

"If we can find plants that prove effective against malaria," says Dr Stangeland, "we hope that African authorities and countries will register the tested medicines and produce them themselves."
An African herbal medicine could be a vital supplement to costly, imported medicines -- and could even replace some of them. Producing medicines in Africa would boost local industries and the economies of countries involved.

Prelude to a larger study

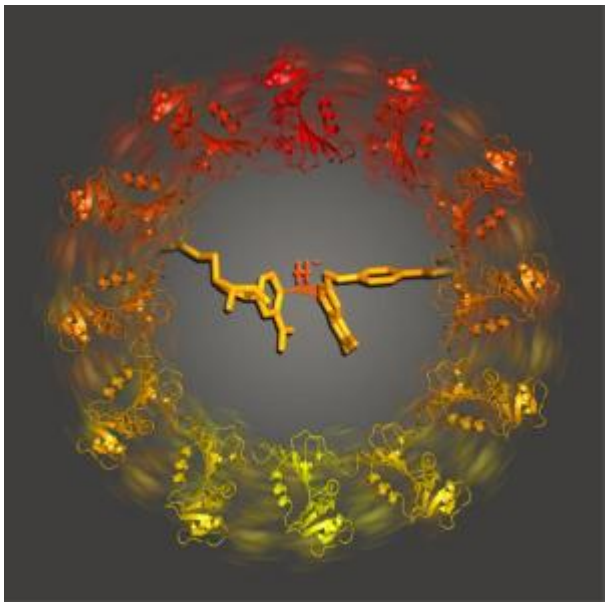
Parallel to experimenting with previously untested plants, the UMB researchers will also produce an overview of plants from nearby areas in Africa that are already mentioned in the scientific literature and may be effective against malaria. An added benefit of the pilot project is that it strengthens cooperation with African universities and scientists working on malaria.
"And this is only the beginning," asserts Dr Stangeland. "We hope the pilot project will lead to a larger, more comprehensive study with clinical tests of the plant-based medicines and insecticides as a main element."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **The Research Council of Norway**. The original article was written by Berit Ellingsen/Else Lie; translation by Darren McKellep/Carol B. Eckmann.

http://www.sciencedaily.com/releases/2011/04/110408075159.htm

E. Coli Enzyme Must Move to Function



A team led by Scripps Research Institute Professor Peter Wright used a mutant of E. coli dihydrofolate reductase to demonstrate that motions in the dihydrofolate reductase enzyme are essential for efficient catalysis. The hydride transfer reaction is shown at the center. (Credit: Image by Lisa Tuttle and Gira Bhabha, courtesy of the Wright lab)

ScienceDaily (Apr. 9, 2011) — Slight oscillations lasting just milliseconds have a huge impact on an enzyme's function, according to a new study by Scripps Research Institute scientists. Blocking these movements, without changing the enzyme's overall structure or any of its other properties, renders the enzyme defective in carrying out chemical reactions.

The study, published in April 8, 2011 issue of the journal *Science*, adds to a growing body of evidence pointing to the importance of movement in the ability of enzymes and other types of proteins to do their job. The findings may also help scientists design more specific and effective drugs targeting enzymes.

"Ever since the first X-ray structures of proteins emerged, scientists have been talking about proteins as though their structures were fixed in space," said Peter Wright, chair of the Department of Molecular Biology and member of the Skaggs Institute for Chemical Biology at Scripps Research who was senior author of the study, "but that is not how proteins work. They are like the machines we build. They have moving parts and they need motion to work."

A Model Enzyme

The new study examined the enzyme dihydrofolate reductase (DHFR) from the common bacterium *Escherichia coli*, which the Wright group has been using as a model for understanding how enzymes catalyze (cause or accelerate) chemical reactions. Most strains of *E. coli* are harmless, but some can cause serious food poisoning.

Bacterial cells cannot live without DHFR, thus this enzyme is the target for many antibiotics. Human cells, and in particular rapidly dividing cells, also use DHFR; drugs that target human DHFR, such as methotrexate, are often used in cancer chemotherapy.

DHFR spurs the conversion of a compound called dihydrofolate (DHF) to a different form, tetrahydrofolate (THF), which is needed by cells for synthesis of DNA. In its chemical reaction, DHFR uses a helper or co-factor, called NADPH. It catalyzes the transfer of a hydride (a negative hydrogen ion) from NADPH to DHF to produce THF. Previous studies by Wright and others have shown that the loops surrounding the active site are flexible, and that one of the loops in particular, called the Met20 loop can adopt two different conformations during the catalytic cycle.

Until now, however, the significance of these motions remained obscure.

Linking Motion to Function

Wright, graduate student Gira Bhabha, and colleagues from both Scripps Research and Pennsylvania State University decided to investigate.
For the new study, the scientists turned to an imaging technique known as nuclear magnetic resonance (NMR) spectroscopy, in combination with X-ray crystallography. Unlike X-ray crystallography, a technique used to determine the structure of proteins in crystals, recently developed NMR methods allow scientists to visualize the motions of proteins in solution. The technique can capture protein motions "in a time scale that is relevant to biology, from microseconds to milliseconds to seconds," said Wright.
To determine the importance of the oscillations, the team set out to make a mutation in the DHFR enzyme that prevented the flexible Met20 loop from moving. To know which amino acids to change, the scientists compared the bacterial DHFR protein sequence to that of the human enzyme, since in the human enzyme the Met20 loop is more rigid.
Using this approach, the scientists successfully produced a rigidified mutatant *E. coli* DHFR. When the scientists examined it using X-ray crystallography, they could see the mutant enzyme's structure was almost identical to the wild type enzyme. However, NMR analysis revealed that the Met20 loop and other parts of the active site were no longer flexible in the mutant.
Significantly, the mutated *E. coli* enzyme transferred hydride at a rate that was 16 fold slower than that of the wild type enzyme -- a substantial loss in enzyme function.
"We demonstrated that locking down the motion in the active site prevents catalysis," said Wright.
While previous work had indicated that enzymes can exist in different shapes and forms and that changes in enzyme shape enable enzymes to bind to their substrates and co-factors or release the products, "this is the first demonstration that motions play a role in the actual chemistry of a reaction," said Wright.

Clamping Down on the Active Site

The scientists reason that, when the *E. coli* DHFR carries out its chemical reaction, motions in the active site assist in pushing NADPH and DHF closer to one another. This proximity makes the transfer of the hydride from NAPDH to DHF more efficient. If the active site can't move, the molecules are not sufficiently close to one another for the chemical reaction to occur. "We think that the mutations prevent the enzyme from clamping down on the hydride donor and acceptor, so they can no longer get as close to each other as is necessary for efficient catalysis," explained Bhabha.
Taking motion into account when designing drugs to either inhibit or increase enzyme function could result in more effective or more specific drugs. For example, because the motions in the bacterial DHFR differ from those in the human enzyme, this difference might be exploited to design drugs that are specific for the bacterial enzyme. "It might help reduce the serious side effects of drugs that target DHFR," said Wright.
"The idea is to harness these motions in drug design," added Bhabha. "It's a difficult and challenging problem, but it could have huge impact."
In addition to Wright and Bhabha, co-authors for the paper "A dynamic knockout reveals that conformational fluctuations influence the chemical step of enzyme catalysis," include Damian C. Ekiert, Ian A. Wilson, and H. Jane Dyson at Scripps Research, and Jeeyeon Lee, Jongsik Gam, and Stephen J. Benkovic at Pennsylvania State University.
The research was supported by the National Institutes of Health and the Skaggs Institute for Chemical Biology.

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Scripps Research Institute**.

Journal Reference:

1. Gira Bhabha, Jeeyeon Lee, Damian C. Ekiert, Jongsik Gam, Ian A. Wilson, H. Jane Dyson, Stephen J. Benkovic, Peter E. Wright. **A Dynamic Knockout Reveals That Conformational Fluctuations Influence the Chemical Step of Enzyme Catalysis**. *Science*, 8 April 2011: Vol. 332 no. 6026 pp. 234-238 DOI: 10.1126/science.1198542

http://www.sciencedaily.com/releases/2011/04/110407141332.htm

Is Beauty Found in the Whites of the Eyes? 'Red Eyes' Associated With the Sad and Unattractive

Eye images of a young adult female (left) and male (right). In the top images the sclera are white and in the bottom images the eyes have been digitally altered. In the study subjects rated 200 such images. (Credit: R.Provine)

ScienceDaily (Apr. 8, 2011) — Beauty is said to be in the eye of the beholder, but a new study reveals that the reverse is also true; unattractiveness is in the eye of the beheld. Research published in *Ethology* finds that people with bloodshot eyes are considered sadder, unhealthier and less attractive than people whose eye whites are untinted, a cue which is uniquely human.

"Red, 'bloodshot' eyes are prominent in medical diagnoses and in folk culture," said lead author Dr. Robert R. Provine from the University of Maryland, Baltimore County. "We wanted to know if they influence the everyday behaviour and attitudes of those who view them, and if they trigger perceptions of attractiveness."

Bloodshot eyes occur when the small blood vessels of the usually transparent conjunctiva membrane on the surface of the eye become enlarged and congested with blood, giving a red tint to the underlying sclera, the "white" of the eyes. Redness of the sclera is believed to be a general but important sign of a person's emotional and biological state.

"If you met a friend with bloodshot eyes it may be unclear whether you should offer sympathy or medical assistance because red eyes may be a result of weeping, allergies or infectious diseases," said Provine. "Comments from our colleagues also suggest that red eyes prompt feelings of discomfort, ranging from increased monitoring of their own eyes to a hint of sympathetic tearing."

In the first empirical test to discover the perceptions and behavioural implications of red eyes Dr. Provine's team tested 208 volunteer students from the University of Maryland, Baltimore County. The volunteers composed of 93 males and 115 females, with an average age of 20.6 years.

The volunteers were shown 200 images of eyes, half with clear white sclera and half with sclera tinted red by digital image processing. The volunteers were asked how sad, healthy or attractive the owners of the eyes were. The results revealed that people with reddened eyes appear sadder, less healthy, and less attractive compared to those with whiter, untinted eyes.

This is the first study to demonstrate that eye redness is perceived as a cue of emotion. Humans appear to be the only species which uses eye colouration as an indicator of either health or emotion. This is because other primates lack the background of white sclera necessary to make the reddened conjunctiva visible.

Sclera colour provides even casual, untrained observers with a quick estimate of the emotional and health status of an individual and the study's ratings of attractiveness suggest that this information does influence our behaviour.

"Standards of beauty vary across cultures, however, youth and healthiness are always in fashion because they are associated with reproductive fitness," said Provine. "Traits such as long, lustrous hair and smooth or scar-free skin are cues of youth and offer the beholder a partial record of health.

Now clear eye whites join these traits as a universal standard for the perception of beauty and a cue of health and reproductive fitness. Given this discovery, eye drops that 'get the red out' can be considered beauty aids."

Story Source:
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Wiley-Blackwell**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Robert R. Provine, Marcello O. Cabrera, Nicole W. Brocato, Kurt A. Krosnowski. **When the Whites of the Eyes are Red: A Uniquely Human Cue**. *Ethology*, 2011; 117 (5): 395 DOI: 10.1111/j.1439-0310.2011.01888.x

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