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make me cry

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NewScientist

WEEKLY August 15-21, 2009

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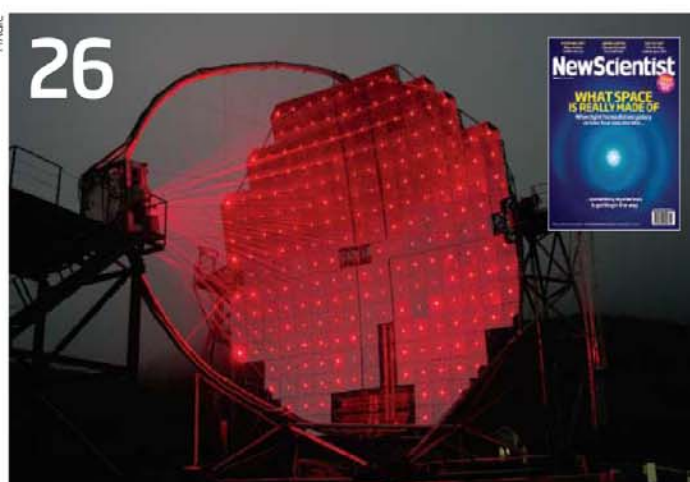
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MAGIC



COVER STORY

The light that came late

Has it revealed the quantum fabric of the universe?

Cover image
Matthias Clamer/Getty

LARA HARWOOD



This fat can make you thin

It effortlessly burns up calories

DAI KUROKAWA/EPA/CORBIS



The second wave

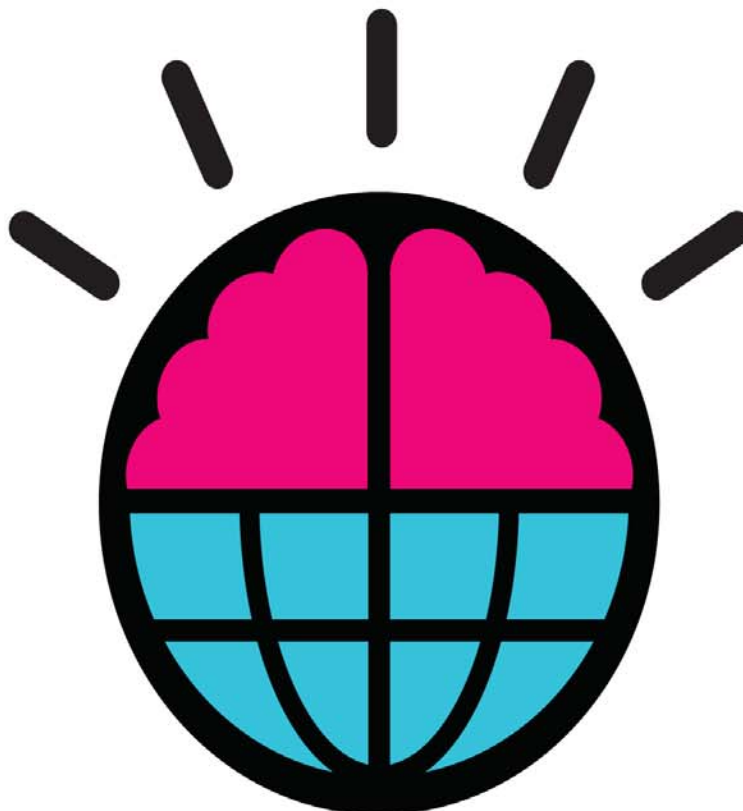
How flu experts are preparing their families for the pandemic's next stage

Coming next week

I, phone

How smartphone apps are changing us

PLUS One shot to end all flu



A new intelligence for a smarter planet.

Leaders make decisions. And their decisions rely on information. That always holds true, whether they're leading a company, a government, an army or a household.

It's what inspired the revolution that saw the Information Age supplant the Industrial Age. Shifted the basis of competition to knowledge, expertise and intellectual capital, the ultimate value of information. And created a torrent of decision-making information.

Today we see the technology industry's real value was never about chips, computers or software. But about revealing what had happened, was happening and might happen across the enterprise. Can you spot key patterns? Extract critical insights from data? Or remove latency and cost from decision-making and implementation?

Questions like these can now be answered far more accurately than ever. But today the ante is being upped by the volume and variety of information, and the velocity of decision-making on a smarter planet.

How much? By 2010, the amount of digital information in the world is predicted to double every 11 hours.

What kinds? Information is being created by billions of people. Flowing from a trillion intelligent devices, sensors and all manner of instrumented objects, animate and inanimate. In all, 80% of this new data growth is unstructured content: email, documents, images, records, video, audio and more.

How fast? To match the speed of transactions, today's systems take in event information in real time, then correlate, analyse and act over 200 times a second – faster than a hummingbird flaps its wings.

So are we doomed to more blind spots, more needles in haystacks, more *garbage in*, more opportunities lost while analysing data?

Thankfully, no. Technology exists to capture, process and turn all this data into actual intelligence. Recognise patterns in unprecedented detail. Capture and analyse changes in markets, trends and consumer preferences faster. And optimise highly complex systems and organisations in entirely new ways.

New approaches like stream computing use advanced software algorithms to track new stimuli, analyse data-in-motion, correlate it with other relevant information. And plug directly into operational and logistics systems, closing the gap between thinking and doing. Indeed, advanced analytics built on heavy-duty mathematics are starting to move us from *sense and respond* or *real time* decision making to something like prediction.

This really could change how the world works. Already, insurance companies see patterns in billions of claims, and detect the fraudulent few. Police correlate street-level information from myriad observations and devices to identify crime patterns – and prevent, rather than punish it. Retailers optimise inventory and transport systems by linking what's in stock to weather forecasts – surprisingly better indicators of consumer behaviour than weather itself.

The list is long, and the change is just starting. Imagine how it will transform the way we pursue economic growth, societal progress, environmental sustainability and cures for disease. The way we interact with each other and with the world.

Let's build a smarter planet. Join us and see what others are thinking at ibm.com/think/uk



A best guess at what flu will do

Our exclusive survey reveals that hard facts on how pandemics evolve are thin on the ground

SO FAR swine flu is behaving exactly as expected. The first wave seems to be finishing in North America and the UK, and as the winter flu season hits the southern hemisphere, countries such as Argentina and Australia are feeling the strain.

We can also predict with some confidence that there will be another wave, and possibly several more after that. And as more people acquire immunity to the circulating H1N1 strain, it will evolve, and its effects could change significantly – because that's what viruses tend to do.

The big question is whether or not the swine flu virus will become more deadly. The truth is we have very little data to go on. Only three flu pandemics have been studied in any great detail during the 20th century, and we know a bit about a few more during the 19th century and earlier. That is how we know they come in waves, and that the disease in the second and third waves often seems to be worse. We don't yet understand enough about what drives the evolution of flu to know if this is always true. That means we can only guess at what might happen next during this pandemic.

But all is not lost. Gut feelings can provide useful insights, and hunches are, after all,

how scientists decide what questions to investigate. So *New Scientist* approached more than 300 influenza and public health experts worldwide to ask them for their best guesses about what might happen next in this pandemic.

Sixty of them responded and on page 6 we analyse what they told us. It is worrying that although most of the respondents weren't unduly concerned about the virus increasing in virulence, more than half seriously doubted that their health authorities would be able cope if it did. About half of the respondents have stashed away their own

"What scientists should be asking now is what we need to improve our predictions of pandemic behaviour"

antivirals or taken other precautions to protect themselves and their families.

Even the best hunches can only take us so far. What scientists should be asking themselves now is what data we need to improve our prediction of how flu pandemics behave.

The Chinese classic *The Art of War* taught us to know both ourselves and our enemy. We should at the very least be freezing blood samples from flu patients and storing them with case details, to see how immune responses correlate with viral changes and the severity of the disease, so we can understand more about flu evolution.

We may not be able to predict the character of the second wave this time, but launching a global data-gathering effort now will mean we'll stand a chance of being able to confront the next pandemic armed with more than just gut feelings. ■

Wanted: ethical weight loss pills

HOW should we deal with the obesity epidemic? The traditional remedy for expanding waistlines – eat less, exercise more – is not working, so drug companies are filling the breach with pills.

Some drugs could make our bodies burn up more calories (see page 38). Others are designed to make us absorb fewer calories and so excrete more. Then there are those that tinker with appetite, stopping people from eating too many calories in the first place.

Though this will be the last thing on the mind of Big Pharma, the third idea is the least dubious ethically. It seems wrong to facilitate overconsumption when the world is under pressure from climate change, limited food supplies and a burgeoning global population. Calories are precious. ■

Stamp out spam

CAN the warm glow of altruism defeat the cold selfishness of spammers? The CentMail project, developed by Yahoo Research, revives the idea of charging to send email, but with a twist. Users will buy "stamps" to attach to their emails, with the proceeds going to a charity that will be named on your posts (see page 5). But not everyone will want to receive emails from do-gooders, especially correspondents who may disagree with your choice of good cause. Let's hope we don't end up trading one kind of spam for another. ■

What's hot on NewScientist.com

SPACE Rovers race to claim Google's moon-landing jackpot

See prototype lunar rovers, made by teams competing to win the \$20 million prize for landing on the moon with no government support

PHYSICS The light that came too late

Gamma-ray telescopes have detected photons from distant galaxies that appear to have travelled at different speeds. Is this a sign of interference by quantum foam? We have the video. Also see page 26

ENVIRONMENT How can governments police climate treaties?

Currently, no satellites can identify human-made carbon dioxide emissions. But a replacement for a NASA satellite that was destroyed during launch earlier this year could pull it off

TECH Game on to evolve the ultimate Mario

Artificial intelligence researchers are racing to build software that can "evolve" to master a version of the 80s classic Super Mario Bros

BLOG Lock 'n' load: Pentagon engages with climate change

American military experts have warned that "climate-induced crises could topple governments, feed terrorist movements or destabilise entire regions". We look at the Pentagon's record of engagement with climate issues

SOCIAL NETWORKING Why do Twitter users love the "fail whale"?

Users seemed unperturbed when hackers recently crippled the

micro-blogging site for nearly two days. But how would you feel if Google's search engine disappeared from the web?

ENVIRONMENT Cutting ozone emissions to save lives

A study of ozone emissions in northern-hemisphere countries suggests that cutting them in one region could save lives in others

For breaking news, video and online debate, visit www.newscientist.com

Boobies alive and kicking

IT HAPPENED to Mark Twain, now it has happened to an enigmatic species of gannet: reports of its death, it seems, are greatly exaggerated.

The Tasman booby (*Sula dactylatra tasmani*) was first described in 1988 from fossils found on Lord Howe and Norfolk Islands, off the east coast of Australia, but went extinct in the late 18th century after being eaten by European sailors.

Now, a team of geneticists, palaeontologists and naturalists has declared the bird very much alive. It is living among its fossil ancestors on both islands, and also on New Zealand's Kermadec Islands to the east (*Biology Letters*, DOI: 10.1098/rsbl.2009.0478).

Geneticist Tammy Steeves, of the University of Canterbury, New

Zealand, and colleagues found a perfect match when they analysed DNA fragments from six Tasman booby fossils and compared them to DNA from a living bird from the islands, *Sula dactylatra fullagari*, described in 1990. Under the rules of taxonomy, the bird reverts to its first recorded name: *S. d. tasmani*.

So why was it thought to be extinct in the first place? "It is a bit curious," Steeves says. Female Tasman boobies are larger than the male, so maybe a female fossil was compared to a living male and didn't match, she suggests.

The Tasman booby is one of several species that have apparently returned from the dead, including a small-eared shrew rediscovered in Mexico last month and a dwarf cloud rat found in a Philippine forest in 2008.



The Mark Twain of gannets

Back to the future

SPHERICAL Mars robots, space buildings made using radio waves and motion-powered space suits. These far-out ideas and others should once again be studied by NASA, a panel has recommended.

NASA's Institute for Advanced Concepts (NIAC) was founded in 1998 to harvest futuristic ideas for space flight and aeronautics. It received \$4 million a year, about 0.02 per cent of NASA's annual budget, and funded more than 100 projects that no one

living up to their contract at the time they were terminated," says committee co-chair Robert Braun, a professor of space technology at the Georgia Institute of Technology in Atlanta.

Three NIAC-funded projects are now "on a path toward one day being a NASA mission", Braun says, including a prototype plasma rocket, an X-ray interferometer that is being considered for NASA's Black Hole Imager mission, and a "star shade", which could help existing space telescopes search for extrasolar planets.

Other projects have had unexpected medical spin-offs, including a skintight space suit that can help children with cerebral palsy walk. "The topics that they invested in... were very advanced in terms of far-out thinking," says Braun, but adds that "a decent percentage had the possibility of turning into something".

The committee does say that NIAC should keep its feet a little closer to the ground, though. It should focus on projects for "10 years and beyond" rather than closer to 40 years, says Braun.

"Far-out ideas such as motion-powered space suits should once again be studied by NASA"

else would touch because of their sci-fi overtones. A combination of budget constraints and internal politics meant NIAC was shut down in 2007.

Now a US National Research Council committee has called for the organisation's return. The committee found that NIAC was successful right up until its final days. "They were definitely

Tamiflu or TLC?

IF YOU think your kid has swine flu, should you dose them up with antiviral drugs? Parents in the UK may be justifiably confused. While the government sticks to its "safety first" strategy of making antivirals available to all, a study published this week concludes that treating children under 12 with oseltamivir (Tamiflu) or zanamivir (Relenza) has little effect (*BMJ*, DOI: 10.1136/bmj.b3172).

The drugs shorten the duration of disease by only a day or so, and

decrease by only 8 per cent the chance that an infected child will spread the virus to others. "The effect is fairly small for most children," says Matthew Thompson of the University of Oxford, who led the study.

Meanwhile Tamiflu can cause vomiting and other side effects, and widespread use increases the risk of the virus developing resistance, says Thompson. He advises parents to treat mild flu symptoms not with antivirals but with medicines to control fever, plus plenty of rest and fluids.

Slow progress on palm plantations

CLAIMS by western banks and supermarkets to be taking a tough line on landowners who trash Asia's rainforests are little more than "greenwash", according to a report on oil palm plantations in the region.

Since 2004, food manufacturers and supermarkets have signed up to the Roundtable for Sustainable Palm Oil (RSPO) standards, promising to report annually on how much of the palm oil in their products has been grown sustainably. Yet "despite

the publicity surrounding the standards, there is little apparent urgency in their application", the Center for International Forestry Research (CIFOR), in Bogor, Indonesia, says in its report, *The Impacts and Opportunities of Oil Palm in Southeast Asia*.

The report concludes that there is an urgent need for legal and political reform to ensure that efforts to make palm oil sustainable are not "hijacked by vested interests".

X marks the carbon

EMISSIONS cuts in North America are a step closer after this week's announcement that the US, Canada and Mexico have committed to creating a map of the biggest

MARK WILSON/GETTY



Tough times call for lofty leaders

"The atlas aims to point out carbon-spewing industries and locate areas for carbon capture and storage"

sources of carbon across the region.

Plans for the "North American Carbon Atlas" were unveiled at the North American Leaders' Summit, which took place on 9 and 10 August in Guadalajara, Mexico.

The project aims to point the finger at carbon-spewing industries, such as oil production, and to locate the best areas for carbon capture and storage.

The plan has been cautiously welcomed by climate researchers. "It will be important for the database to follow changes from year to year," says Diana Liverman of the Environmental Change Institute at the University of Oxford. But if the project is well done it could be the basis for carbon trading, she adds.

The announcement came as the Pentagon declared that climate change is a threat to national security. This could help make the case for emissions cuts when the US Senate decides on the fate of climate legislation passed in June by the House of Representatives.

The highest office

WHEN the going gets tough, the presidents get taller. So says social psychologist Terry Pettijohn of Coastal Carolina University in Conway, South Carolina.

He looked at the heights, ages and facial attributes of the 11 elected US presidents over the past 75 years, and compared them with economic and social indicators such as unemployment and birth rates. "What we're seeing is that taller candidates

perceived to provide security in troubled times. The results were presented last week at a meeting of the American Psychological Association in Toronto, Canada.

Although the study did not include data from 2008, Barack Obama (186 cm) appears to fit the trend. Republicans searching for a candidate to take him on in 2012 may need to aim high.

"The taller presidential candidates are preferred when times are more difficult"

are preferred when times are more difficult," says Pettijohn.

Examples of lofty leaders include Franklin Roosevelt, who steered the US through the Great Depression (188 centimetres), and Bill Clinton, who campaigned with the phrase "It's the economy, stupid" during the recession of the early 1990s (189 cm). The relatively petite Harry Truman won two elections during the prosperous 1940s (175 cm).

Hard times also make for presidents with larger chins and smaller eyes, says Pettijohn. He thinks that voters associate these features with strength and maturity – qualities that could be

Penny post returns

"DO GOOD. Fight Spam." That's the slogan promoting CentMail, an attempt to resurrect the idea that charging for email cuts spam because spammers can't afford to pay for their millions of messages.

Past attempts failed as people proved unwilling to stump up. With CentMail subscribers will buy a virtual book of hundreds of stamps. The proceeds will go to charity and the recipient sees who you are supporting.

Tapping into the altruistic glow that giving to charity can provide makes it more likely the system will be adopted, says Sharad Goel, who helped develop CentMail. "We think this is a more socially efficient approach to reducing spam."

If large numbers of people sign up, spam filters could be adjusted to automatically let stamped emails through, making it easier to search for spam among the rest.

60 SECONDS

Half-speed ahead!

The Large Hadron Collider will restart in November at half the energy it was designed to reach. Protons will initially smash together at 7 trillion electronvolts. Faulty electrical connections mean the equipment could not safely handle higher energies. Even so, this still beats any other collider, and it shouldn't stop the LHC making discoveries.

Algae kill horse

Environmentalists have blamed intensive farming for the death of a horse and the collapse of its rider on a beach in Brittany, France. Run-off from farms has led to a mat of algae on many beaches, which releases toxic hydrogen sulphide as it rots.

Cancer in retreat

Death rates from cancer have been falling in the US over the past 75 years, reveals a study analysing WHO mortality data for US citizens born since 1925 (*Cancer Research*, DOI: 10.1158/0008-5472.CAN-09-0357). The rate of decline in deaths is most marked in the youngest people, at 26 per cent per decade, four times that in the eldest groups.

Almighty alien smash

The aftermath of a collision between two alien worlds has been spotted. Observations by the Spitzer Space Telescope reveal masses of glassy material around the star HD172555. This would have formed under huge temperatures and pressures, pointing to the collision of two large bodies, say Carey Lisse of Johns Hopkins University in Baltimore, Maryland, and colleagues.

Gel snares sperm

A gel that traps semen in the vagina has been developed by Patrick Kiser and his team at the University of Utah. It is a liquid at normal vaginal acidity, but solidifies into a fine polymer mesh on contact with semen, which is slightly alkaline. Kiser says it could provide women with contraception and protection from HIV.



ALEXANDRA BOULAT/VI

Mahogany out, oil palms in

DAI KUROKAWA/EPH/CORBIS



WHAT'S NEXT FOR SWINE FLU?

We asked flu scientists how they were preparing themselves and their families for the second wave

Vian Azzu

AS THE swine flu pandemic continues to sweep the world, what do public health officials, epidemiologists and flu researchers think will happen in the coming months? When *New Scientist* asked 60 of them, it turned out that half are concerned enough about the possibility of a virulent swine flu outbreak to take precautions such as acquiring a supply of Tamiflu for their families. Though most do not think it likely that a nastier strain will emerge,

many are worried that if it did, their local hospitals and other parts of the health infrastructure could not cope.

Since the emergence of H1N1 swine flu in Mexico and the US five months ago, the virus has affected 168 countries in all continents. More than 160,000 infections have been confirmed and the true figure could well be 10 times that if cases have gone undetected. "This flu spreads very well," says Angela McLean, co-director of the Institute for Emerging Infections at the University of Oxford. While over 1000 people are known to have died, this is a fairly low fatality rate, she says.

No one can say for sure what will happen in the coming months. In the 1918 pandemic, the virus mutated and became more pathogenic over time. Last week, when swine flu fatalities doubled in Argentina – now in its winter flu season – the fear was that the virus had changed, though genetic sequencing proved that wasn't the case.

Although it is not yet possible to predict how the virus might evolve, researchers have hunches like everyone else. So *New Scientist* decided to email a list of carefully selected individuals from around the world. We asked three simple questions: how concerned were they about an increase in viral virulence, did they think their country's infrastructure could cope if this happened, and were they taking extra personal precautions for themselves and their families.

The exercise was not intended to be scientific. The aim was simply to get a snapshot of opinion at this stage of the pandemic. Do their personal views matter? Probably. After all, these are the people who work day-to-day either studying flu or planning how to deal with it, and they influence regional, national and international strategies for managing the pandemic.

John Oxford, professor of virology at the Institute of Cell and Molecular Biology in London thinks the timing of the straw poll is right. "It's done just at the right moment," he says. "We have reached a balance point between the summer wave and a possible autumn wave. This is an excellent time to stand back a little and reassess and reflect upon the flu situation."

How likely is it that a more virulent

PANDEMIC VIEWS

"I do not understand why we fail to learn these lessons time and time again."

Laurence Tiley of the University of Cambridge warns that overliberal distribution of antivirals may hasten resistant variants of swine flu

"My country is poor, there are many people without money for food. If there are vaccines, they will be available for people who have money."

Gabriela Goujoulova of the National Diagnostic Research Veterinary Medical Institute in Bulgaria is unsure that her country's infrastructure can cope with the pandemic

"The widespread use of Tamiflu in May stopped [flu] from taking off in schools."

Angela McLean of the University of Oxford points out that the UK's decision to distribute Tamiflu widely in May was a good one, because it prevented school closures during exam periods

"I do not feel personally at high risk of illness."

Robert Dingwall of the University of Nottingham in the UK is not planning to stockpile antivirals or antibiotics because he is confident of their continued availability to the population in his country

"Should the scale of the pandemic exceed existing realistic worst-case scenarios, which is entirely possible, then it is quite certain that life as we know it will be difficult to maintain."

Andrew Singer of the University of Oxford points out that the UK is well prepared for the pandemic

"A repeat of the 1918 pandemic, which happened in the pre-antibiotic era, is not going to happen."

Modern medical facilities are the reason, says an anonymous senior researcher on flu vaccines in the US

"The 1918 flu pandemic was like a missile into a virgin community"

strain will emerge? The majority of respondents did not rule it out: two thirds said they thought that higher virulence was "possible". Only a small proportion said it was "likely" (see table, page 8).

One respondent, Laurence Tiley, a molecular virologist at the University of Cambridge, says there is no reason to expect that the virus will become substantially more virulent. There have been too few pandemics to make any concrete predictions, he explains.

Around 30 per cent of respondents believe there is a fifty-fifty chance or greater of increased virulence. Oxford adds a caveat to this group's choice.

"There is a tendency for people to hark back to 1918 when there was an increase in virulence, but it's different now. In 1918 it was like a missile into a virgin community, where everyone was susceptible," he says. Many people's immune systems have encountered a similar seasonal flu virus, which might lend them some protection against H1N1-type viruses, he adds. "I don't envisage at all a 1918-type scenario, and I'm glad that your experts here agreed."

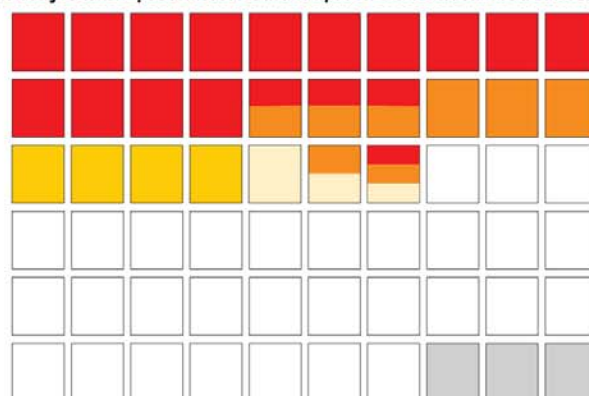
However, Walter Fiers, a molecular biologist at the University of Ghent in Belgium warns that there is still no way of knowing whether the 2009 H1N1 flu virus will mutate, making vaccines

Preparing for the worst?

Half of the flu experts surveyed by *New Scientist* had taken at least one special measure to prepare themselves or their families for a severe outbreak of H1N1 swine flu*

Q: PLEASE TICK ONE OR MORE OF THE FOLLOWING. Have you taken special measures in anticipation of a severe H1N1 flu outbreak by:

- Acquiring a stock of Tamiflu for you and your family (18)
- Acquiring antibiotics to protect you and your family against bacterial pneumonia secondary to flu (8)
- Stocking food, water, radio, heat or light, as some governments recommend in case of a breakdown of civic services at the height of a pandemic (4)
- Receiving pneumococcus vaccination to protect you and your family (3)
- None (30)
- Other e.g. masks, hand-washing (3)



*Based on a straw poll of 60 epidemiologists, virologists and public health officials

under development useless. So he and many of his colleagues are pressing for systematic surveillance of the virus to pick up any changes in behaviour.

A big worry is the possible appearance of a hybrid virus, one that combines the high transmissibility of H1N1 swine flu with the virulence of H5N1 bird flu, where 30 per cent of those infected die. "The nightmare scenario is that someone who is already infected with H5N1 gets swine flu," which would give the two viruses the opportunity to recombine, says John Edmunds, an epidemiologist at the London School of Hygiene and Tropical Medicine, UK.

Doubts also emerged over the ability of health infrastructures to cope, should the pandemic mirror that of 1918. Over half of those polled answered that they are "very" or "extremely concerned" that their local health services would be unable to deal with such a virulent wave of swine flu.

So are the respondents worried enough about a severe swine flu outbreak to take their own special measures? They are divided. Half say they have taken no measures. Reasons were mixed: some believe a serious flu outbreak unlikely, others don't feel they are at risk of serious disease, and many stated that they can easily access

drugs via their local health infrastructure if necessary. Robert Dingwall, director of the Institute for Science and Society at the University of Nottingham, UK, says, "I am not planning to stockpile. I have every confidence in the availability of [UK] stocks of antivirals and in their continued availability."

The other half of those questioned are taking at least one precaution in anticipation of a severe swine flu outbreak. These include acquiring antivirals such as Tamiflu, or antibiotics for them and their families. Some have had the pneumococcal vaccine to protect against pneumonia, which can occur as a secondary infection. A few have even stockpiled food and water in their homes in case civic services, such as transport networks and food supplies, break down (see table, page 7).

Some of them seemed motivated by concern that stocks of antivirals or antibiotics were either absent or likely to run out. One health official in Africa said people in her country are "totally relying on the grace of God" to protect them from the pandemic. Although the respondents were evenly split between lower and high-income countries, around two-

"The nightmare scenario is that someone infected with bird flu gets swine flu"

thirds of those who had taken special measures were from high-income countries, such as the US, western Europe, Japan and Australia, where government plans are relatively well formed and shortages of medicines are unlikely.

Oxford says that stocking antivirals is not necessary for most people, but he is surprised that more respondents have not chosen to do so because they have easier access to medicines via their work. He adds that such personal preparations can sometimes be prudent, for example, if a person was travelling to the southern hemisphere where swine flu cases are rising fast in the winter season.

These actions may prove to be unpalatable for policy-makers in well-prepared countries because they can fuel public anxieties. Dingwall warns that stocking antivirals may be rational for an individual, but if everybody followed suit the result would be "the very shortages that we might fear".

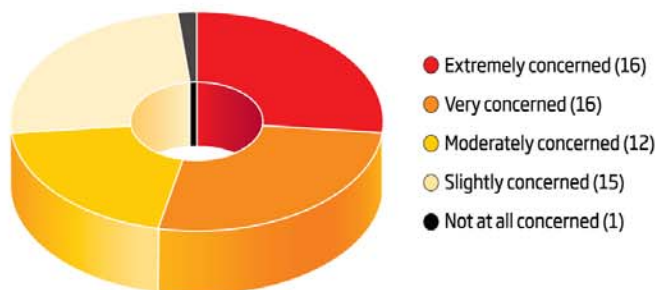
When *New Scientist* asked Marie-Paule Kieny, director of the World Health Organization Initiative for Vaccine Research, to comment on the results, she felt the snapshot represented a balanced view of the pandemic. "The experts seem to understand well the challenges ahead: they recognise the risks, but also the uncertainty of these risks," she says.

In the coming months, health authorities should not be complacent just "because they know that the vaccine is coming in a few months and because they have large stocks of Tamiflu in their freezers," says Walter Fiers of the University of Ghent. After all, if the virus mutates significantly before a substantial percentage of the population are vaccinated it will be useless. What's more, Tamiflu resistance can emerge if the drug is widely used on those with very mild symptoms. "The situation needs to be carefully monitored," says Fiers. "Influenza has surprised us many times before." ■

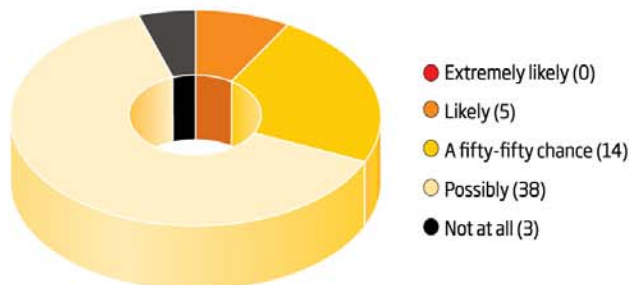
The next wave

Many of those surveyed are pessimistic about how their local health infrastructure will cope with a more virulent version of flu, but most are uncertain whether such a strain will emerge*

Q: How concerned are you that your local health infrastructure would not be able to cope if the next wave were very virulent? (e.g. similar to 1918 Spanish flu, with 30% of population infected at some point and a death rate of 2-3%)



Q: In your opinion, how likely is it that a more virulent version of the current pandemic H1N1 flu will circulate later in the year?

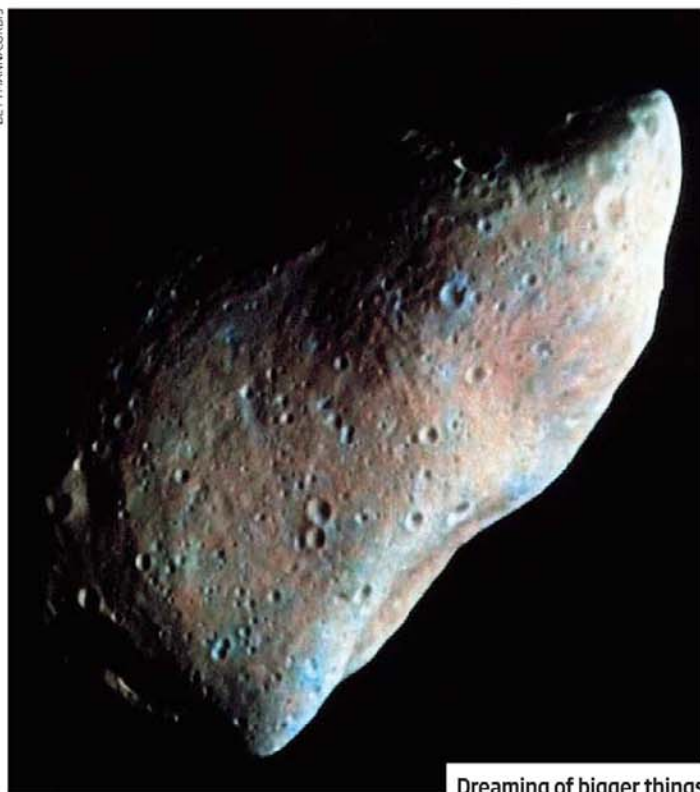


*Based on a straw poll of 60 epidemiologists, virologists and public health officials

MORE ONLINE

For the latest news on the swine flu pandemic go to www.newscientist.com/special/swine-flu

BETT MANN/CORBIS



Dreaming of bigger things

Did huge crunches form the planets?

David Shiga

PERHAPS we should thank rapid-assembly asteroids for spawning the planets. New simulations suggest that dense swarms of boulders collapsed under their own gravity to make the building blocks of our solar system.

The planets are thought to have formed from a disc of dust and gas around the infant sun. The initial process is well known: dust grains clumped together, forming objects in the millimetre-to-metre range. However, it is not known how the growth process continued. The gas in the disc should have put a drag on the new boulders, causing them to spiral into the sun before they could grow further.

Evidence is now mounting that the next step was a sudden leap forward, skipping intermediate sizes to make asteroids hundreds of kilometres across – massive

enough to resist gas drag.

This basic idea is decades old, but it attracted renewed attention in 2007 and 2008 following simulations by a team led by Anders Johansen of the Max Planck Institute for Astronomy in Heidelberg, Germany, and by another team led by Jeffrey Cuzzi of NASA's Ames Research Center in Moffett Field, California. These showed that turbulence in the nebula could have concentrated objects less than a metre across in dense enough swarms to collapse under their mutual gravity and form large asteroids tens to hundreds of kilometres across.

"If either one of these models turns out to be right... this will be a big step forward," says John Chambers of the Carnegie Institution in Washington DC.

Now a new study has found evidence that such a process did occur in our solar system.

It is based on the size of objects in the asteroid belt. Estimates from telescopic surveys suggest there are millions of the smallest asteroids, which are less than a kilometre across, with the numbers of larger ones dropping off sharply. Yet this size distribution and number would once have been different: asteroids can grow by sweeping up smaller objects, and shatter if they collide with an object of similar size.

Alessandro Morbidelli of the Côte D'Azur Observatory in Nice, France, led a team that simulated the evolution of the asteroid belt, modelling a variety of starting populations (*Icarus*, DOI: 10.1016/j.icarus.2009.07.011).

When the team started with small asteroids a few hundred metres to a few kilometres across – a scenario that might have occurred in the absence of a "sudden leap" – they ended up with far more small asteroids than are seen today. Another scenario started solely with 100-kilometre objects, but ended up with too few asteroids at the high end of the size range. But they did find a good fit with today when they started with a mixture of sizes between 100 and 1000 kilometres across, suggesting that large asteroids did form spontaneously during the solar system's development.

"It's a nice story and they have a lot of evidence supporting their point of view," says Scott Kenyon of the Harvard-Smithsonian

"Asteroids hundreds of kilometres across appeared - too massive to be dragged into the sun"

Center for Astrophysics in Cambridge, Massachusetts. But he cautions that it may have been difficult to complete planet formation in a reasonable time if there were no small asteroids at the outset. Small asteroids boost the rate of collisions needed for growth through their gravitational interactions with larger ones, he says. ■

Stowaway insects imperil Darwin's finches

THE famous Galapagos finches could be among the first casualties of mosquitoes that are stowing away on aircraft, potentially bringing fatal viruses to the islands.

Live mosquitoes captured in the holds of aircraft arriving on the Galapagos from mainland Ecuador were found to survive and breed on the islands (*Proceedings of the Royal Society B*, DOI: 10.1098/rspb.2009.0998). Although none of the captured mosquitoes carried lethal viruses such as the West Nile virus (WNV) – which decimated bird populations in the US after arriving in New York in 1999 – they have the potential to do so.

WNV has been reported in Colombia and Argentina, and could have reached Ecuador, says Simon Goodman of the University of Leeds, who co-led the research team. It is not only the finches that are at risk. "West Nile virus also affects reptiles and mammals, and so could impact other iconic Galapagos species such as marine iguanas and sea lions," Goodman says.

Goodman and his colleagues found 74 live insects after searching the holds of 93 aircraft landing on Baltra Island in the Galapagos. Of these, six were *Culex quinquefasciatus* mosquitoes, which transmit WNV and the parasite that causes bird malaria. Two more were caught in aircraft that landed on nearby San Cristobal.

"The consequences for wildlife could be severe," says Marm Kilpatrick of the University of California, Santa Cruz. The findings are probably an underestimate of the true numbers of mosquitoes arriving, he says.

By comparing genes from mosquitoes caught on the mainland with those on the Galapagos, the researchers were able to show that arrivals from Ecuador survive and breed with Galapagos mosquitoes.

Goodman recommends stepping up the spraying of aircraft with insecticide before they leave mainland Ecuador. Andy Coghlan ■



The LMC now has a stealthy rival

A dim companion for the Milky Way

Ken Croswell

A LARGE satellite galaxy may be lurking, hidden from view, next door to our own.

Sukanya Chakrabarti and Leo Blitz of the University of California, Berkeley, suspected that the gravity of a nearby galaxy was causing perturbations that have been observed in gas on the fringes of

the Milky Way. "We did a large range of simulations where we varied the mass of the perturber and the distance of closest approach," says Chakrabarti. In the best-fitting simulation, the unseen galaxy has about 1 per cent of the Milky Way's mass, or 10 billion times the mass of the sun.

That's a lot. It means the object has roughly the same mass as the

Milky Way's brightest satellite galaxy, the Large Magellanic Cloud (LMC).

Right now, says Chakrabarti, the galaxy is roughly 300,000 light years away from us – about twice as far away as the LMC. But the simulations suggest it follows a highly elongated elliptical path, and about 300 million years ago it swept through our own galaxy just 16,000 light years from the galactic centre – closer in than Earth – disturbing the Milky Way's outskirts as it went.

"Overall, it is a very plausible scenario," says Abraham Loeb at the Harvard-Smithsonian Center

for Astrophysics in Cambridge, Massachusetts, who was not part of the study. "Of course, the fact that we don't see such a massive satellite is an issue."

Chakrabarti suggests that the galaxy has remained hidden because it is not a brilliant spectacle. Whereas the LMC glistens with bright young stars and the gas that spawned them, the unseen galaxy may be dead, containing old stars and little gas.

To make matters worse, the simulations suggest that the galaxy orbits ours in the same plane as our galaxy's disc. If it is now on the opposite side of the galaxy from us, it could be hiding behind the thick gas and dust in the galactic plane. "It's very likely to be in a region of very high obscuration," says Chakrabarti. The work will appear in *Monthly Notices of the Royal Astronomical Society*.

By further studying the distribution of gas, Chakrabarti hopes to pinpoint the galaxy's location so that astronomers will know where to look for it. This parallels the way astronomers in the 1840s discovered Neptune from irregularities in the motion of Uranus caused by gravitational tugs from the more distant planet. If the unseen galaxy exists, it will be the first nearby galaxy detected through its gravity rather than its starlight. ■

Hidden patterns reveal a book's true meaning

A STATISTICAL method that picks out the most significant words in a book could help scholars decode ancient texts like the Voynich manuscript – or even messages from aliens.

Humans find it easy to identify the words that capture the theme of a text – for example, that "whale" is a key word in *Moby Dick* – but this is a difficult task for computers. Now Marcelo Montemurro, a systems biologist at the University of

Manchester, UK, and colleagues have developed a method to identify word importance based on a branch of mathematics called information theory. "It seems that what we call semantics or meaning has a signature at the level of the statistics of words," says Montemurro.

Simply counting the frequency of words in a text is not enough, as connective words such as "for" and "the" confuse the picture. Important words tend to clump in paragraphs and chapters that deal with the topic they relate to, but this only provides a crude guide, says Montemurro.

For a more detailed analysis, the team calculated the "entropy" of each

word, a measure of how evenly distributed it is, in both the original text and in a scrambled version in which the words appeared in a random stream. From the difference between the two entropies multiplied by the frequency of the word, the team generated that word's "information value" in the text.

Connective words are fairly uniformly distributed in both the scrambled text and the original, so their information value is low.

"Important words tend to clump in paragraphs and chapters that deal with the topic they relate to"

Significant words have a high value, because they tend to clump in the original and are relatively common. When the team applied the technique to *On the Origin of Species*, the top 10 words included: species, varieties, hybrids, forms, islands, selection and genera (www.arxiv.org/abs/0907.1558).

Similar methods could have applications in biology, perhaps to identify genes that carry "value". "That's the place where the most direct application of this stuff is," says Marcelo Magnasco at Rockefeller University in New York. "When you're looking at the genome, it's really an alien language." Lisa Grossman ■

Our ancestors learned to walk in the trees

EARLY humans may not have walked on their knuckles before they stood up on two feet. Instead, our ancestors walked upright in the trees and then set foot on the ground, according to a study comparing the wrist bones of our closest relatives.

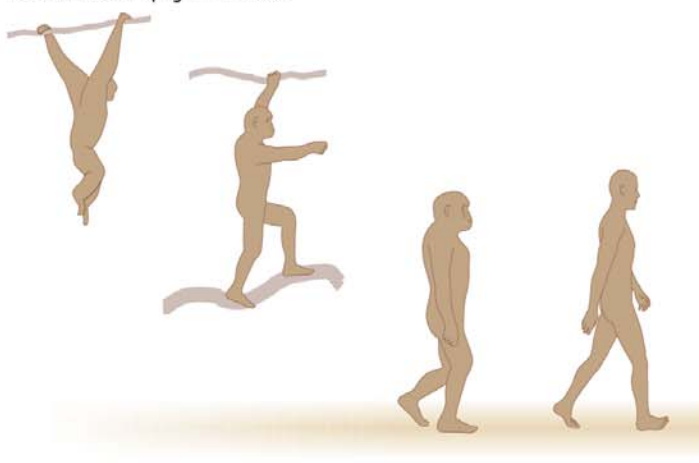
Sceptics of this “trees to two feet” idea argue that the ancestor of all African apes, including gorillas, chimps and humans, must have been a knuckle-walker, because both gorillas and chimps knuckle-walk. They also have specialisations such as ridges and concavities on the wrist bones that keep the palm of the hand from collapsing onto the ground when bearing weight. It seems reasonable to think that bipedal walking in humans evolved from this intermediate stage, they argue.

Not so, says Tracy Kivell, a palaeoanthropologist at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany. She and her colleague

Daniel Schmitt of Duke University in Durham, North Carolina, compared the wrist bones of chimps, bonobos, gorillas and other more distantly related monkey species. They found that many of the supposed knuckle-walking adaptations in chimp and bonobo wrists are

Hit the ground walking

Rather than descending from the trees and then learning to walk, our ancestors may first have walked upright in the trees



missing in gorillas but present in non-knuckle-walking monkeys (*Proceedings of the National Academy of Sciences*, DOI: 10.1073/pnas.0901280106).

Since chimps and gorillas use different bones for knuckle-walking, the activity could well have evolved separately in the two apes, Kivell says. If that is the case, it means the ancestral African ape need not have been a knuckle-walker and neither did the ancestral human.

Kivell thinks the wrist bones of chimpanzees may instead have adapted to stabilise the wrist while standing on one tree branch and holding onto another, with knees and elbows bent (see diagram). “When you’re walking on ice, you bend your elbows and knees to make yourself more stable,” says Kivell. “You do the same thing when you’re walking on a branch.”

Indeed, modern chimps and bonobos do exactly that. The posture may put more bending strain on the wrist, leading to the kinds of adaptations visible today, Kivell says. She and her colleagues hope to test this idea in the future.

Advocates of the knuckle-walking theory are not convinced. Early *Homo* species show knuckle-walking adaptations on several wrist bones that were not included in Kivell’s study, says David Strait, a palaeoanthropologist at the State University of New York at Albany. The best explanation for this, he says, even considering the bones Kivell studied, is that early humans, like all other African apes, walked on their knuckles. **Bob Holmes ■**

Vaccine targets malaria’s weakest link

A VACCINE that targets the malaria parasite at a vulnerable point in its development could form part of a strategy to eradicate the disease.

Unlike other vaccines in the pipeline, which are designed to protect individuals who have been bitten, this one aims to sabotage the life cycle of the malaria parasite, *Plasmodium*, by stopping it from passing back from humans to mosquitoes.

While preventing this transmission wouldn’t help an infected individual directly, it would benefit the population as a whole, says the study’s lead author Nirbhay Kumar of Johns Hopkins Malaria Research Institute in Baltimore, Maryland.

“If you are living in a village and the mosquito that bites you gets infected from you, it can transmit the malaria parasite to other people in the village,” he says.

To create the vaccine, Kumar’s group used genetically modified bacteria to make proteins identical to some of those involved in the parasite’s sexual development. They injected the proteins into mice and baboons, which generated antibodies. When the team added *Plasmodium* gametes to blood samples from these animals, the antibodies bound to and blocked the proteins. If a mosquito sucked up some of this blood it would still get a bellyful of the gametes, but they would be unable to combine and spawn new adult parasites.

One shot of the vaccine led to a 93 per cent reduction in malaria transmission, and the figure

went up to 98 per cent after a booster shot (*PLoS ONE*, DOI: 10.1371/journal.pone.0006352).

This could be used alongside another vaccine being developed by GlaxoSmithKline, called RTS,S/AS02A, which blocks *Plasmodium* transmission from mosquitoes to humans. By attacking the parasite’s

“One shot of the vaccine led to a 93 per cent reduction in malaria transmission”

life cycle at two points, it may even be possible to wipe out malaria. “If this vaccine is as promising in clinical trials as it has been in this study, then it may prove to be an important part of an integrated disease-control strategy aimed at eradicating *Plasmodium*,” says Andrew Read of Pennsylvania State University

in University Park, who works on the ecology of infectious diseases.

Kumar admits that getting the vaccine approved will be a long process, but hopes that human trials can start by 2012. Vaccine approval is a priority as existing methods of controlling the disease are under threat. In May, researchers reported that some *Plasmodium* strains in Cambodia are developing resistance to our best antimalarial drug, artemisinin, while mosquitoes are becoming resistant to pesticides.

Economics may prove the biggest obstacle to any eradication strategy. It is not clear who would pay for a vaccine that does not protect individuals – although a special report by the World Health Organization says that this type of vaccine could be one of the most cost-effective ways to fight the disease in the world’s poorest countries. **Vian Azzu ■**



Why the highest peaks are always at low latitudes

IS IT just a coincidence that all the world's tallest mountain ranges lie at low latitudes? Apparently not, as it seems warmer climates enhance mountain growth.

Three things control how high a mountain range is likely to grow: the strength of the underlying crust, the magnitude of tectonic forces pushing upwards, and the amount of erosion wearing the mountains down. All of the world's highest ranges have strong underlying crust, but until now it wasn't clear whether the world's tallest peaks were dominated by strong uplift or minimal erosion.

Using satellite images, David Egholm of Aarhus

University in Denmark and colleagues mapped all the major mountain ranges between 60° north and 60° south, plotting their land surface area against elevation. They compared this with the average altitude of the snowline and the latitude of each range. They also modelled the effects of glacial erosion.

At low latitudes, the warmer climate tended to push the snowline higher, and the mountains grew taller, they found (*Nature*, DOI: 10.1038/nature08263). "Erosion processes are more effective above the snowline where glacial erosion dominates," says Vivi Pedersen of Aarhus University. Peaks are rarely more than 1500 metres above the snowline, meaning that low-latitude ranges like the Himalayas (pictured) have a head start over high-latitude ranges because their snowline is much higher.

Lead thyself not into temptation

THINK you can resist temptation? Then you are more likely to succumb, say Loran Nordgren and his colleagues at Northwestern University in Chicago.

The team took 53 smokers and promised them money if they did not light up while watching a clip of the film *Coffee and Cigarettes*. Each subject was given a cigarette and had to decide where to put it: in another room, on a desk, in

their hand or in their mouth. The closer the unsmoked cigarette, the more money they would gain.

Before this, the smokers had been given a bogus psychological test and then split at random into two groups: one was told they had "a high capacity for impulse control" and the other was labelled "low". The latter group tended to put the cigarette far away, while those told they had

good control risked holding it or putting it in their mouths. This bravado was their undoing, as the closer the cigarette, the more likely they were to smoke it.

Experiments without the bogus test showed the same effect. People confident that they could keep a snack for a week without eating it were more likely to crack than self-doubters, they say in a paper to appear in *Psychological Science*. The way to stay out of trouble, says Nordgren, is to avoid temptation.

Bugs bare their magnetic bits

THE genetic code for tiny biological magnets called magnetosomes has been cracked.

The granules are produced by oxygen-hating bacteria and help them navigate, using the Earth's magnetic field, towards deep, oxygen-poor regions of the ocean.

Tadashi Matsunaga at the Tokyo University of Agriculture and Technology in Japan and his colleagues singled out the genes by comparing well-known magnetic bacteria to a distantly related magnetic species. By identifying genes common to all species, they pinpointed those used for making magnetosomes (*Genome Research*, DOI: 10.1101/gr.088906.108).

The discovery may herald the production of synthetic nanomagnets, which could lead to improvements in MRI cancer scans and new ways to isolate medically useful molecules.

Insults are best taken lying down

IF YOU must offend someone, wait until they're lying down: a brain-scan study shows that people may contain their anger better when horizontal.

Seated subjects who heard personal insults showed brain activity linked to so-called approach motivation. "In this state, one might be more likely to attack," says Eddie Harmon-Jones of Texas A&M University in College Station, who led the study. The activity disappeared when students took their insults lying down, though they still felt angry.

"Maybe in the reclining state you're more likely to brood," says Harmon-Jones. He worries that MRI studies which scan subjects as they are lying down could miss the neural signs of some emotions.

Ugly skin growths saved Yushchenko

UNSIGHTLY skin growths helped to save the life of Ukrainian president Viktor Yushchenko after he was poisoned five years ago. That's the verdict of doctors who have treated and monitored Yushchenko since a would-be assassin laced his soup with dioxin in 2004.

It now turns out that Yushchenko was probably saved by the benign but ugly lumps called hamartomas that grew on his face and body - seen in the December 2004 photo below - which helped isolate the dioxin from his vital organs. They also helped to break down the poison, known more precisely as TCDD, by producing powerful enzymes called cytochrome P450s, which are normally confined to the liver.

The benign growths developed from skin stem cells. "A new organ was created out of normal structures of the skin, made to detoxify the dioxin," says Jean-Hilaire Saurat, the dermatologist heading the team that treated Yushchenko at the Swiss Centre for Human Applied Toxicology in Geneva.

"He's not completely clean yet, but we've got more than 95 per cent of it out now," says Saurat.

Reporting the work in *The Lancet*, Saurat adds that the findings will be invaluable for treating and detecting milder cases of dioxin poisoning or contamination (DOI: 10.1016/s0140-6736(09)60912-0).



Burrowing black holes - the ultimate star assassins

SOME of the brightest flashes in the universe may be the result of black holes burrowing into stars and devouring them from inside.

The flashes are known as gamma-ray bursts because most of their energy is in the form of high-energy radiation, including gamma rays and X-rays. The longer flashes, lasting at least a few seconds, have long been thought to signal the deaths of massive stars that have run out of fuel, causing them to collapse to form black holes, unleashing powerful jets of radiation in the process.

Now an alternative explanation has been given new lease of life: a black hole may instead be an external attacker that dives into the belly of a massive star and consumes it.

Although both scenarios involve a black hole, an invader might take more time to finish gobbling up the star's matter, releasing radiation for longer. Calculations by Maxim Barkov at the University of Leeds, UK, and Serguei Komissarov of the Space Research Institute in Moscow, Russia, show this could account

for lingering X-ray emissions seen several minutes after some gamma-ray bursts begin, which have proved hard to explain (www.arxiv.org/abs/0908.0695).

"Where this model really shines is explaining the late emission," says Chris Fryer of Los Alamos National Laboratory in New Mexico - one of the physicists who first proposed the burrowing black hole theory in the 1990s. It remains to be seen if it can account for the extreme brightness seen at the beginning of gamma-ray bursts, he says.

Thrush yeast is a same-sex breeder

A YEAST responsible for thrush can reproduce homosexually - potentially explaining ways it develops resistance to treatment.

When *Candida albicans* cells reproduce by mating, they have two sex types, "a" and "alpha". Richard Bennett of Brown University in Providence, Rhode Island, and his colleagues mixed the two types and saw matings between same-sex cells, but only a few (*Nature*, DOI: 10.1038/nature08252).

They saw many more when they boosted a pheromone secreted by "a" cells that draws same-sex cells together. They did this by disabling an enzyme in "a" cells that usually destroys the "same-sex" pheromone.

Now they want to find out what could make this happen in nature, such as changes in acidity in the mouth, gut or vagina.

In 1999, a lethal strain of a related yeast, *Cryptococcus neoformans*, emerged on Vancouver Island in British Columbia, Canada, through same-sex mating. "The findings suggest that unisex mating may be linked to virulence," says Joe Heitman of Duke University in Durham, North Carolina.



NEEL BOWMAN/FLPA

Birds shrink as temperature rises

THE list of species that are shrinking due to climate change keeps on growing. Birds now join sheep and trees in wasting away as the temperature rises.

To discover whether there had been any change in bird size over the past century, Janet Gardner of the Australian National University in Canberra and colleagues measured the wingspan of 517 birds held in museum collections. The birds, belonging to eight species native to Australia, had been collected between 1860 and 2001. They found that four species had shrunk by up to

4 per cent in 100 years (*Proceedings of the Royal Society B*, DOI: 10.1098/rspb.2009.1011).

Two factors could explain this. Environmental degradation could have made the birds' diet poorer, or warmer temperatures could have given an edge to birds with smaller body sizes, as they are better able to cool off. Using feather length as a proxy for nutritional status in birds, the researchers were able to rule out the possibility that smaller birds were less well nourished than their ancestors. This left global warming as the most likely culprit.

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*Example based upon comparison between Golf 1.4 TSI 160 PS manual and Golf 1.4 TSI 160 PS 7-speed DSG. Official fuel consumption for Golf 1.4 TSI 160 PS manual in mpg (litres/100km): urban 34.9 (8.1); extra urban 54.3 (5.2); combined 44.8 (6.3). CO₂ emissions 145g/km. Official fuel consumption for Golf 1.4 TSI 160 PS 7-speed DSG in mpg (litres/100km): urban 37.7 (7.7); extra urban 54.3 (5.2); combined 47.1 (6.0). CO₂ emissions 139g/km.



Which one is real?

Hurt my avatar and I feel pain

THE dream of many computer game designers has come one step closer to reality with the demonstration of a technique that allows people to identify more fully with a virtual body or avatar. It builds on previous research in which neuroscientists gave subjects the sensation that they were having an "out-of-body experience", and tricked people into experiencing the sensation that their avatar was being touched.

In the latest experiment, a camera filming each subject's back produced an image that was projected through a head-mounted display to generate a virtual body 2 metres in front of them. Repeated stroking of the participant's back, combined with the sight of the doppelgänger being stroked, created the sensation that their virtual body was being

touched (*PLoS ONE*, DOI: 10.1371/journal.pone.0006488).

Vibrating pads with flashing lights were positioned on the subjects' backs, so that they saw flashes on their virtual bodies at the same time as the vibrating pads on their real bodies were activated. The two

"Seeing the doppelgänger being stroked created the sensation that it was being touched"

did not always coincide, and when participants were asked to indicate at which point on their virtual body they felt the vibrations, some reported that the vibrations were at the site where the flash appeared, rather than where the pad was activated.

The system could potentially help people get a feel for prosthetic limbs.

Beagle 2 crash theory disproved

WHAT happened to the UK's Beagle 2 Mars probe on Christmas Day 2003 is once more unclear.

In December 2008, engineers led by Madhat Abdel-Jawad at the University of Queensland thought they had cracked it when their simulations showed Beagle 2's gyroscopic spin was too fast for it to remain stable – so it would have tumbled and burned up in the Martian atmosphere (*New Scientist*, 20 December 2008, p 24).

The Beagle 2 team is far from convinced. Arthur Smith of Fluid Gravity Engineering in Emsworth, Hampshire, UK, says the Australian team failed to simulate atmospheric entry in a gravity field, or allow for Beagle 2's offset centre of gravity, meaning the simulations were flawed. With the parameters set correctly, Smith's simulations show that Beagle 2 did not tumble.

70%

drop in Twitter-related internet traffic reported at the height of a denial-of-service attack on Twitter.com last week

'Black boxes' for future iPhones

TAMPERING customers and accessory makers alike are testing the patience of iPod and iPhone maker Apple – so it is inventing its way around the problem.

In a patent filed on 6 August, Apple reveals that it aims to thwart iPod and iPhone users who cause damage to their gadgets and then claim new ones under warranty (tinyurl.com/1l2h1r). "Consumer abuse includes exposing devices to liquids, extreme temperatures, excessive shock, and may also include tampering," the firm says.

The patent describes an in-gadget sensor and circuit

combination designed to record these "consumer abuse events" so shop staff can assess them when presented with a dead machine.

The third-party hardware people buy for their devices can also damage them – resulting in returned machines that cost Apple money. So in another patent the firm reveals a "sniffer" that sits between one of its gadgets and, say, an amplifier dock (tinyurl.com/1fyqwe). This senses every voltage on every socket pin and ensures that external hardware is not causing power changes that may interfere with future software upgrades.

The idea? Anyone wanting to produce Apple-compatible kit will have to buy one of its sniffers.



"Computer agents don't get bored... or embarrassed"

Nick Jennings of the University of Southampton, UK, who has come up with a hard-bargaining computer program that negotiates on the buyer's behalf to secure a good deal online (BBC Online, 6 August)

Defeat worms, send them to quarantine

The best way to stop highly virulent worms wreaking havoc on the internet is to give it an immune system

Anil Ananthaswamy

IT IS 0530 UTC, 25 January 2003. A computer worm named Slammer has just unleashed one of the most devastating attacks on the internet ever. Within minutes, it infects nearly 90 per cent of vulnerable computers. Major net links break down, ATM machines fail and airlines have to cancel flights.

What was impressive about Slammer was the overwhelming speed of infection. There was no chance to intervene. Six years on, our defences are little better.

Scott Coull of the University of North Carolina at Chapel Hill and Boleslaw Szymanski of the Rensselaer Polytechnic Institute in Troy, New York, want to change that. They have devised a system to combat highly virulent, malicious worms by embedding defence mechanisms in key parts of the internet – akin to endowing it with an immune system.

To understand the limitations of the current strategies, imagine there's an outbreak of a biological virus. The major airports in the world decide not to let people disembark from planes flying in from an infected region but instead let the aircraft take off for other parts of the world.

"Obviously, the local community served by the airport might be protected, but what about the rest of the world where the plane might go to next?" asks Coull. A much more effective strategy would be to quarantine infected planes and prevent them from flying anywhere.

Coull and Szymanski are

proposing something similar to stop worms spreading through the internet. The piece of self-replicating software that is a worm starts by randomly scanning the internet for computers with a security hole that it can exploit. Once it finds a vulnerable computer, the worm transfers itself and starts the process all over again. A worm's virulence depends on two things – how many vulnerable computers there are and how fast it can search them out.

Slammer was extremely efficient at scanning for vulnerable hosts, taking only minutes to infect a population of 75,000 computers. Another

"The key to containing such worms is to persuade the computers that form the net's core to cooperate"

worm, called Code Red, was able to infect nearly 360,000 computers on 19 June 2001. Even though Code Red took hours rather than minutes to spread it still cost businesses billions of dollars.

To figure out how to handle such threats more effectively, Coull and Szymanski decided to model a worm capable of reaching about 4300 hosts every second – the effective rate achieved by Slammer. They assumed that 1 per cent of all computers in the internet were vulnerable, though no existing worm is capable of infecting so many computers. The combination of scanning rate and vulnerability made their worm an order of magnitude more

dangerous than Slammer in terms of infecting computers, says Szymanski.

The key to containing such worms, say Coull and Szymanski, is to persuade the computers that form the internet's core to collaborate. The core is composed

of tens of thousands of so-called "autonomous systems". Each one is managed by an internet service provider (ISP), such as Sprint or British Telecom.

In their simulation, the researchers endowed each autonomous system with the ability to detect the presence of an infected computer, which may give itself away by making a series of random requests to connect to other computers, most of which will fail. Once an autonomous system detects a threat within its network, it stops receiving and forwarding messages from the infected computer. The system also informs its peer autonomous systems about the identity of the threat. To minimise the risk of



STEPHEN SIMPSON/GETTY

false alarms, peers do not act until the number of systems reporting threats hits a predetermined threshold.

However, once a genuine threat has been identified, all autonomous systems can isolate the infected computer or computers, neutralising their ability to spread the worm. Eventually, the infected computers can be cleaned up. According to the simulation, about 30 to 35 per cent of the autonomous systems in the internet would have to cooperate for the strategy to work (*Computers and Security*, DOI: 10.1016/j.cose.2009.07.003).

To mount such a defence, the companies running the

autonomous systems would have to cooperate and trust each other, says Coull. Tackling worms involves changes to the infrastructure and an ability to shut down traffic flowing through an ISP – all of which can go against the business agreements that ISPs have with each other. But as Coull points out, not defending against virulent worms might harm businesses more in the long run.

Adrian Baldwin, a security specialist at Hewlett-Packard Labs in Bristol, UK, says that ISPs may be reluctant to quarantine machines that are critical to their business. Adopting the system could put ISPs in the invidious position of having to choose between stopping worms and keeping their customers connected. "As a security officer, you need to think about what are the benefits of doing that blocking, versus the losses that will happen to the business because I have done that."

ISPs may opt to spend their money on other measures – such as speeding up the installation of software patches to plug security holes, notes Baldwin. Or they may have other security priorities, as hackers shift to more covert activities aimed at pilfering money from unsuspecting web users. Nevertheless, worms remain a threat, especially if levels of cyber warfare, such as the targeting of government sites, increase. "Then you might start to see worms [again] and that becomes more important to deal with," says Baldwin.

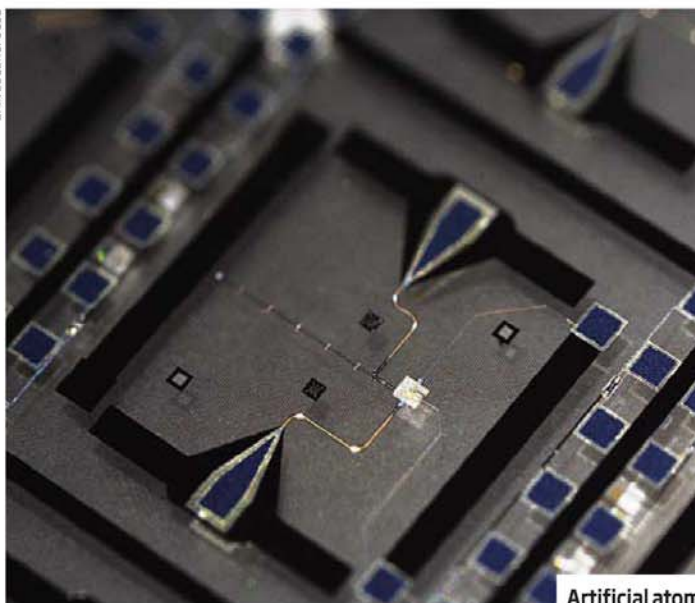
And if ISPs can be persuaded to cooperate in boosting the internet's immune system, the strategy could also tackle spam – which, at any given time, is the work of a small set of computers spewing out junk email.

"[About] 60 per cent of internet traffic is spam at the moment," says Coull. "A similar warning and filtering system could actually stop most of the spam from even traversing through the internet." ■



An attack is minutes away

ERIK LUCERO/UCSB



Artificial atom

Could the power of five bring quantum computers alive?

MEMO to the developers of superfast quantum computers: eschew the binary systems used in conventional computers. By switching to a five-state system, you will find it easier to build the staggeringly powerful machines. So claim Matthew Neeley and his team at the University of California, Santa Barbara (UCSB).

The development of quantum computers has so far followed the traditional binary computing model, using quantum bits – qubits – in which two states can be encoded in the form of the quantum spin angle in atoms, electrons or photons. It is the ability of such particles to exist in multiple quantum states at once that should one day enable quantum computers to perform vast numbers of calculations simultaneously.

Neeley's team has demonstrated it is possible to take that further and operate a five-state quantum system, using a superconducting aluminium and silicon circuit on a sapphire wafer that, at 0.025 kelvin, acts like an "artificial atom". The five-state unit (pictured) is known as a "qudit".

"There's more information stored in a qudit than a qubit, so a given computation can be done with fewer qudits," Neeley told *New Scientist*.

By firing microwave photons of

five different frequencies into the circuit, they were able to make it to jump between five discrete energy levels. "We also developed a quantum measuring technique that can distinguish between all of these levels," says Neeley.

Because, in probabilistic terms, the circuit's five quantum states are able to exist simultaneously, the team had a working qudit on their hands (*Science*, DOI: 10.1126/science.1173440).

One qudit alone is of little use, however. Jonathan Home at the US National Institute of Standards and Technology in Boulder, Colorado, says

"The team was able to make an 'artificial atom' jump between five discrete energy levels"

Neeley's team needs to extend its basic system in such a way that two or more qudits can transport information between them, which would allow more complex computational operations to be undertaken.

"Designing the sort of system where two qudits interact, but still retain the interesting properties of a five-level system, will be a major challenge," Home says. Paul Marks ■

If the lights are blazing, all's well in a nation

NIGHT-TIME images taken from kilometres above the Earth could help us better understand the economies of some of the planet's least developed countries. So say the US economists behind a method for measuring changes GDP using the intensity of street lights and other night-time lighting.

A better way of estimating GDP is badly needed, especially for poorer nations. Data collected by national governments is weak when it comes to informal sectors of the economy, such as street markets. In some countries, such as Liberia, economic information systems are so poor that meaningful data is sometimes non-existent.

Satellite images could help plug the gap. Nations tend to build new roads and expand residential areas as they become more wealthy, both of which increase the number of lights that can be seen from space.

By comparing 11 years of satellite data on night-time light intensity with GDP estimates, David Weil and colleagues at

Brown University in Providence, Rhode Island, developed a method for estimating changes in GDP from light measurements alone. When applied to some far-flung places, the formula casts doubts on official figures. Their paper has been submitted to *The American Economic Review*.

In the Democratic Republic

of the Congo, for example, World Bank figures suggest that GDP shrank by 2.6 per cent between 1992 and 2003. Weil's findings point to a 2.4 per cent increase over the same period. "That inclines me to think that the Congo's problems are with its statistical information, not its economy," says Weil.

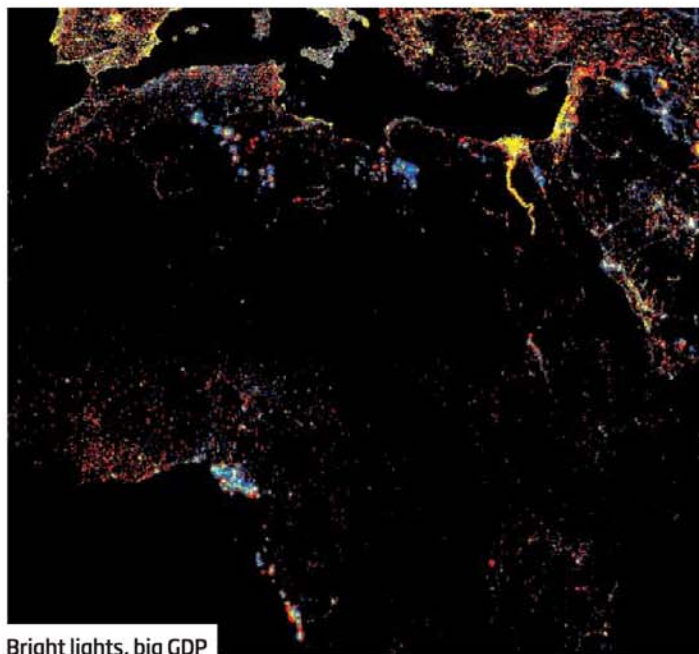
GDP measurements could ultimately be improved by using a weighted combination of conventional data and light measurements, but Weil says that

researchers need first to get a better understanding of the link between economic activity and light intensity. An increase in population, for example, can increase light intensity even during poor economic times.

Economists will also have to consider whether the link between GDP and light intensity, which was established using information on rich nations, works in the developing world. "They're extrapolating the relationship to places we don't know about, where it might not work," says Jan-Peter Muller, a remote-sensing specialist at University College London.

If such problems can be ironed out, the light data could become a rich source for economists. It is more regularly updated than traditional economic indicators and can be used to study how lighting levels in different localities change relative to each other – something that is often averaged out in national figures.

An even richer source of data may also become available: NASA researchers are developing a proposal for Nightsat, a remote-sensing satellite designed to produce higher-resolution images of the light emitted from populated areas. **Jim Giles** ■



Bright lights, big GDP

Why it's time to hand over the spying to cluster satellites

HOW can you keep a single subsystem failure from turning a billion-dollar spy satellite into orbiting space junk? Break it into a cluster of modules, each of which can easily be replaced, suggests the US Defense Advanced Research Projects Agency (DARPA).

Today's satellites carry multiple instruments and support systems. This integrated approach minimises weight and launch costs, but increases the chance of expensive delays such as those which clouded the launch of the Pentagon's SBIRS surveillance satellites. Such complex

units can also be disabled by the failure of a single subsystem.

DARPA programme manager Owen Brown envisages splitting complex satellites into a wireless network of modules that communicate with each other across a few kilometres of space. Upgraded or replacement modules could be launched as needed and add themselves to the cluster.

In July, after a round of technology development that included work on wireless networks, fault-tolerant computing, and power transfer in space, DARPA picked a team led by

Orbital Sciences of Dulles, Virginia, to design the test system.

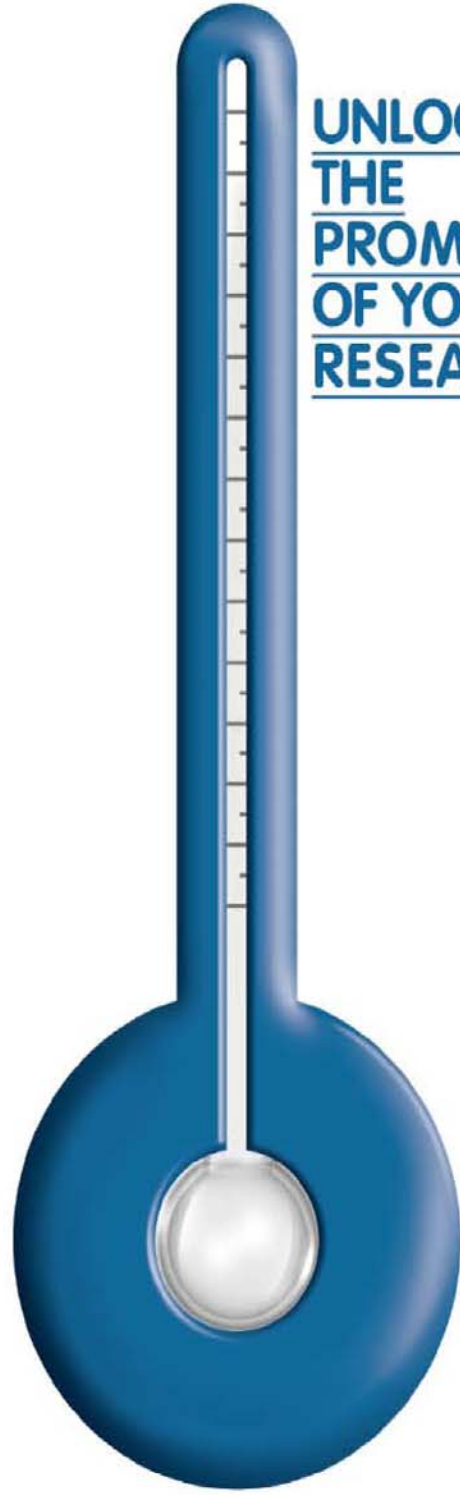
The key to making such a "fractionated" system resilient will be the distributed computer systems and the wireless network, David LoBosco of Orbital told the American Institute of Aeronautics and Astronautics last year. So four payload instruments, two data recorders, two high-speed downlinks, and two high-speed number crunchers will be distributed among the modules. If a module is lost it would be relatively easy to replace.

Indeed, Daniel Hastings of

the Massachusetts Institute of Technology talks of the ease of launching new modules and installing upgrades as "an almost seductive advantage" compared with attempting the repair of existing satellites. But while DARPA's Orbital Express has managed a successful satellite rendezvous, NASA's DART spacecraft collided with its target satellite.

Initial costs for the fractionated system may be higher because of the need to duplicate support systems but lifetime costs should be lower, says Annalisa Weigel of MIT. Standardised modules "could really knock down the cost of spacecraft, and that's going to provide phenomenal access to space for entrepreneurs and scientists," she told *New Scientist*. **Jeff Hecht** ■

"The key to making the satellite clusters work will be the distributed computer systems"



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It makes sense, whichever way you look at it.



Don't react, think

From swine flu to mistakenly locking people up, grappling with risk means juggling our emotional and analytical selves, says **David Spiegelhalter**

THE British players in the unfolding swine-flu drama are providing a riveting case study of different responses to risk. While the government tries to look cool, controlled and consistent, tabloid newspapers hunt sensation and citizens exhibit every emotion from nervous anxiety to stoical acceptance. In the meantime, mainland Europe revels in portraying the UK as a land gripped by pestilence. Perhaps we all need a crash course in considering the unintended consequences of overreacting to events.

Take a couple of memorable overreactions. In the year after the terrorist attacks on the US on 11 September 2001, so many people avoided airline travel in the US by driving that there were about 1500 additional deaths on the roads, or six times the number of air passengers that died on 9/11.

Then there is the trouble that officials can cause when they panic. In 1995, an urgent fax was sent out to doctors in the UK warning that third-generation oral contraceptives were associated with a doubling of the risk of deep vein thrombosis. Women stopped taking the pill in droves, there were thousands of subsequent additional abortions, and all because of an overreaction to a risk of 1 in 7000 being doubled to 2 in 7000.

Perhaps the greatest danger of overreaction, though, happens when a government feels it must respond to popular clamour after a high-profile event involving an innocent or vulnerable victim. When a baby is killed, or there



is a murder by someone identified as mentally ill or someone on probation, people are reasonably shocked and feel that "something must be done" to prevent such things happening again.

Why do they think that extra bureaucracy will help? While the causes of individual tragedies may be apparent, this does not mean that similar events can be easily prevented in future. That's because they are essentially unpredictable: the underlying problem is that the most shocking "bad" things happen to, or are done by, people deemed to be low-risk, and so attempts to prevent all "bad" things often have a high cost for little apparent

gain. This idea is probably best explained through an example.

Let's consider what are officially termed "serious further offences" (SFOs) in the UK. Suppose 1 in 1600 of the total number of people on probation commits such an offence, but that some are more likely to offend than others. These high-risk people offend at three times the rate of the low-risk. Suppose 7.5 per cent of probationers are classified as high-risk. If you locked them all up, what might be the consequences?

"Contrary to popular opinion, civil servants are well aware of the tendency to overreact to risk"

It is counter-intuitive, but you would make very little impact, and all for considerable cost and loss of liberty.

How so? Imagine you had 8000 people on probation. Of these, 600 (7.5 per cent) are high-risk, and 1 of them commits an SFO. The other 7400 are low-risk – only one-third as likely to commit an SFO – and 4 of these offend. Overall, by locking up all high-risk cases you will prevent only 1 out of the total of 5 offences: 80 per cent of the SFOs will still occur. So what appears to be a reasonable policy could be an overreaction.

A group of deaths provokes even more concern and the expectation of action. For example, vast sums are spent on rail safety after high-profile accidents. This has had a substantial impact: not a single passenger was killed in a train accident in the UK in 2008, compared to 60 years ago when there were at least 50 every year.

However, it is easy to overlook the fact that 279 members of the public were killed on UK railways in 2008, around the same number as 60 years ago, nearly all of them trespassers and suicides. Deaths that occur singly and are seen as the victim's fault arouse little demand for action.

Contrary to popular opinion, senior civil servants are well aware of the tendency to overreact to risk. The UK has had a series of semi-official bodies set up to identify official overreaction and discourage excessive interference in people's lives, including the recently disbanded Risk and Regulation Advisory Council.

The RRAC identified, among other things, that a proposed UK standard for tree inspection, “put together by a rather narrow group led by arboriculturalists who stand to gain from its adoption”, threatened to lead to the large-scale felling of trees which posed little danger. The RRAC declared itself as “fighting zero-tolerance of risk”, but its successor body has yet to be established.

Meanwhile, the slow increase in swine-flu deaths is encouraging claims that there has been an overreaction by government and media. The worst-case scenario planned for by the UK’s Department of Health projects is 65,000 deaths, while a more optimistic (and possibly more reasonable) set of assumptions projects 6000 deaths, 1 in 10,000 of the population. That is below the number expected from seasonal flu.

But it is the age distribution of swine-flu deaths that is crucial: young people are apparently least resilient, and if that mortality rate occurred across all age groups in England and Wales, it would double the annual number of deaths among 5 to 14-year-olds, from about 700 to 1400.

Why does this appear alarming, when for oral contraceptives we were happy to say that a doubling of a very low risk of thrombosis was no reason for panic? Perhaps because we are so unused to child deaths. Or because the 700 extra deaths should not be compared to the current total of 700, but to the much smaller number – about 200 – that occur unexpectedly in previously well children?

In any case, it shows that reacting to risk is a constant juggle between the emotional and the analytical parts of our mind. Looking coolly at the numbers certainly helps, but there’s no denying that will only ever be a part of the story. ■

David Spiegelhalter is Winton Professor of the Public Understanding of Risk at the University of Cambridge

One-minute interview

Anti-company men

Exxon and Dow Chemical have been among the targets of inventive pranks mounted by The Yes Men

What are The Yes Men all about?

We want to make the point that if you let corporations do what they want, the world will go to hell in a hand basket. We advocate that citizens be able to decide their own futures rather than let big corporations do it.

How do you feel about reactions to pranks like the one in which you unveiled an industry standard for determining how many deaths are acceptable when achieving large profits?

It’s a continual surprise. There’s lots of research showing that, under certain conditions, when people are given a message by someone in authority they absorb it and do what the authority says. What’s shocking isn’t so much that people believe what we say or that we are the corporate people we’re pretending to be; it’s that they don’t react when these entities say horrible things.

Climate change is going to be your next mission. What made you go for that?

When you have very powerful, wealthy, entrenched interests in the US fighting action on climate change, the only way to fight is to take to the streets and demand action. We have a president and a lot of people in Congress who wouldn’t mind doing the right thing, but they’re beholden to certain interests. If they can point to people protesting, then they have proof the public want action. They can say to the industrial forces pressuring them: I can’t do what you’re telling me to do because people are taking to the streets. This is a crucial part of democracy.

Will it work? What about climate deniers?

We don’t know. We hope so. There are millions and millions of people who feel very strongly that it’s a big problem we need to do something about. Even if a small percentage of them take to the streets, they are going to be visible. We have a project to appeal to the climate change deniers: we’re asking people to write tabloid articles in the style of climate deniers. We’re going to launch them in a website later this month: see www.theyesmen.org/blog/become-a-tabloid-writer.



PROFILE

Andy Bichlbaum (left) and Mike Bonanno – aka The Yes Men – got together to set up parody websites such as www.gwbush.com. Their latest film is *The Yes Men Fix the World*

At one point you claimed to be a spokesman for Dow Chemical, saying Dow would pay whatever it took to clean up after the accident at Bhopal. What effect did that have?

It wiped 3 per cent off their stock price; we didn’t expect that. There were reports that the Securities and Exchange Commission was looking for us, and people suspected we might be short-trading. It goes to show what our culture has come to, when the only reason people could think of for doing a thing like that was to make money.

Your day jobs are in academia. What do you make of the way research is funded?

We feel strong sympathy for the people doing amazing research who can’t get funded because the application isn’t a big moneymaker. In pharmaceuticals, chronic illness is privileged over curable illness because it makes a lot more money. You’ve got to wonder what our priorities are.

Interview by Kat Austen

Read more of this interview and a review of the film at www.newscientist.com/article/dn17573

Climate of apathy

From Dave Riddlestone

Judging by the number of reports in *New Scientist* of research into technologies that are likely to worsen global warming, the adverts for gas-guzzling cars that adorn your pages, and the carbon footprint of many of the global warming researchers as described in George Marshall's article (25 July, p 24), not many of the scientific community truly believe in the problem.

If scientists are not true believers, how do they expect the rest of us to be? Do scientists really expect us to do as they say rather than as they do?

In the defence engineering community where I work, I often hear arguments that global warming is a research funding cash cow, or that we are undergoing a natural warming period in the interglacial cycle, not a man-made event.

I think I believe in global warming, so I had cavity wall insulation installed a couple of years ago, but my gas consumption has remained unchanged. I have a huge south-facing roof, but I am told that, although the lifetime of

solar panels is now long enough that they reduce carbon emissions even when the carbon footprint of their manufacture and installation is taken into account, they still cost more than one would be likely to save in energy bills. What should I try next?

I call on scientists, if global warming is real, to help us to believe, and to mitigate it by researching cost-effective solutions.

Farnborough, Hampshire, UK

From Tom Dixon

Whether or not anthropogenic climate change is a reality, as George Marshall asserts, is quite a separate issue from whether or not we should change our behaviour accordingly. The presupposition that there exists some form of common interest shared by the "brotherhood of man" embodies the disjuncture between the world view of those who advocate "green" policies, and the broad swathes of people most directly affected by them.

The presupposition conceals a fundamental question: why should any person make sacrifices for the benefit of others? In the absence of a religious or even



utilitarian moral imperative there is no rational basis for demanding such a sacrifice. If climate change does not affect me personally, materially and directly, within the limited window of my remaining years, why should I care?

For the record, I don't.

Bristol, UK

From Charles Lansdale

George Marshall wonders why people don't take climate change seriously. Maybe the quality of weather forecasting has some impact on the public perception of climate modelling, even though the two are not related.

The British Met Office, with its new supercomputers, warned us that this summer would be hotter and drier than average, and to take all the necessary precautions. So far, it has been an average English wet summer with one short heatwave.

The Met Office also predicted that the recent UK bank holiday would be a washout. In fact, it was a beautiful day and hoteliers in the popular seaside resort of Bournemouth complained bitterly because everyone had stayed away.

If computer modellers can't get a few days right, how can we expect people to believe predictions about 50 years hence?

Eastbourne, East Sussex, UK

Calorie conundrum

From Rick Jefferys

Bijal Trivedi explains how the method of preparation and

condition of the food we eat makes a big difference to the number of calories available to the body (18 July, p 30). Like many other commentators on this subject, however, she fails to consider the related possibility that all digestive systems may not be equal. It seems to be assumed that all calories that pass the lips eventually enter the body from the digestive tract.

Yet individuals can have significantly different gut flora and other digestive capacities, leading to substantial differences in the proportion of calories absorbed from food. Even a 5 per cent difference in digestive efficiency could mean the difference between being fat or slender. Exercise, particularly running, which certainly has a dynamising effect on the gut – in part by hurrying food through the system – could reduce the calories absorbed.

Digestive efficiency has to be as important as calorie intake and metabolic rate, yet it never seems to get a mention. Is it the yuck factor that prevents it being discussed in polite company?

Berkhamsted, Hertfordshire, UK

From Susan Grote

The illustration accompanying Bijal Trivedi's article focused on foods that contain fewer calories than would be calculated by current methods. Surely the problem contributing to obesity is nutrition labels that err in the other direction.

What is really needed is better education about reading the label:



Enigma Number 1558

Mirror image

ALBERT HADDAD

The digits in the two addition sums are all non-zero and have been replaced by letters and smiley faces.

$$\begin{array}{r} \text{☺☺☺☺☺☺} \\ + \text{MIRROR} \\ + \text{MIRROR} \\ + \text{IMAGE☺} \\ = \text{IMAGE☺} \end{array} \quad \begin{array}{r} \text{MIRROR} \\ + \text{IMAGE☺} \\ = \text{☺☺☺☺☺☺} \end{array}$$

Different letters stand for different digits, the same letter stands for the same digit, and each emoticon can be any digit.

If the six-digit summation of either addition is a mirror image (i.e. reverse) of the other, find the value of MIRAGE.

WIN £15 will be awarded to the sender of the first correct answer opened on Wednesday 16 September. The Editor's decision is final. Please send entries to Enigma 1558, *New Scientist*, Lacon House, 84 Theobald's Road, London WC1X 8NS, or to enigma@newscientist.com (please include your postal address).

Answer to 1552 Prime products: The digits are 1, 7 and 8

The winner Mikey Teal of Acaster Malbis, York, UK

the importance of looking for fibre content, of eating complex rather than simple carbohydrates, and of avoiding “enriched white flour” and various forms of sugar.

The final sentence of the accompanying editorial points to the virtues of many unlabelled foods (18 July, p 5), but that doesn't mean that all foods with no label are healthy. Just pay a visit to your local coffee shop and contemplate the thousands of “empty” calories you can consume in a week if you have a 480-kilocalorie coffee drink, plus a bagel, a muffin, a cookie, a croissant or a doughnut for breakfast every day.

The rule to apply when looking at such displays of baked goods is: “If you don't know what's in it, don't put it in your mouth.” Nutritional labels do count. *San Francisco, California, US*

The editor writes:

■ Labels do not underestimate calorie content, but the overestimate can be substantially greater for many healthier foods than it is for less healthy options. As a result it can be hard to make the lower calorie choice between a more and less healthy option if their labels indicate a similar calorie content.

From Shyam Rangaratnam

I can confirm first-hand that medium-rare burgers can contribute to weight loss. After eating one in a college pub, I lost 10 kilos in a week. I won't go into the details.

E. coli aside, the promotion of undercooked food as a way of burning more calories seems like the height of gluttony. Would it not be more prudent to eat smaller amounts of well-cooked food? Surely there is more to be gained, both individually and globally, from a reduced demand for food.

We need to find healthy ways to feel full. I, for one, will look for alternatives to having uncooked beef in my gut.

Grimsby, Ontario, Canada

Insensitive shellfish

From Peter Carr

In his article on invertebrates' rights, Peter Fraser referred to research into hermit crabs that purported to show they feel and remember pain (11 July, p 24).

I am a langoustine fisherman, and my experience of langoustine behaviour over the past 30 years suggests that they don't feel pain. Pain presumably evolves as a mechanism for avoiding, or at least minimising, damage, but if the outer shell of a crustacean is penetrated the damage has already been done, so internal pain receptors would be pointless. Often when prawns are together in a box they latch onto each other



with their claws, sometimes piercing the shell. I have never seen any attempt to escape or disengage in the way you would expect if this were “painful”.

The research into hermit crabs only showed that they do not like electric shocks, which is not necessarily the same as feeling pain. It has applications in fishing where weak electrical stimulation prompts bottom-dwelling fish to rise up into the trawl net, and encourages razor clams from their burrows so you can pick them up.

Moreover, hermit crabs, unlike many other crustaceans, have soft bodies, unprotected by a hard shell, so conceivably have a use for a pain reflex. A better experiment might be to buy shellfish destined for export and hence doomed, and inflict damage on them to gauge their reaction.

Undoubtedly there is some

sensory mechanism because they respond with autotomy, the voluntary amputation of an irreversibly damaged limb. But I'm willing to bet that any sensory response would fall short of what we would define as feeling pain. *Kyle, Ross-shire, UK*

Snuggle for survival

From Richard Frost

Fern Elsdon-Baker criticises Richard Dawkins's dogmatic approach to evolution and his coining of rigid metaphors for the processes involved (18 July, p 24).

The misuse of metaphors in evolutionary theory goes back to Charles Darwin himself. He used Herbert Spencer's “struggle for survival” in a late edition of *On the Origin of Species*, which did little to modify Alfred Tennyson's talk of “nature red in tooth and claw”, and he repeatedly referred to the wedge – where new species force their way into an ecosystem to the detriment of others.

Such images make the theory ugly and can be inaccurate. Evolution often takes place without struggle: a mutation finds a niche and snuggles into it. Asteroidal extinction or a new volcanic island, for example, can open myriad opportunities for survivors and chance arrivals. *Whitehaven, Cumbria, UK*

Election illusion

From Gordon Drennan

Stephen Battersby's article on the disputed Iranian election results seemed rather ideological for a publication that claims to be about science, and written for scientists (27 June, p 10).

The mainstream media habitually decides its attitude towards a country by applying the rule: “the enemy of my enemy is my friend, and the enemy of my friend is my enemy”. It then treats any evidence that confirms that initial assessment as authoritative

and dismisses everything else.

So, if you riot in the streets of a country that the west sees as a friend you are a “terrorist”, but if it is a country that is one of our “enemies” you are a heroic fighter for democracy – irrespective of the merits of your cause or the methods you use to pursue it.

Battersby fell into the same trap by proclaiming that the evidence of statisticians in the US suggested the official election results were a fraud, on the basis of only one fact: that the results for one candidate, who got so few votes they made no difference, didn't have the right distribution of digit values in it. The same study reported that all the other candidates did; one wonders how the results of this one candidate came to be manipulated when theirs weren't.

The fact that the declared election results did not match the exaggerated expectations of some western commentators, doesn't make it a fraud.

Burton, South Australia

For the record

■ We should have stated that artist Rosamond Purcell recreated Ole Worm's Wormianum as pictured in “Enigma of the 23-year-old baby” (25 July, p 46).

■ Feedback's pick-out contributor is called Lynton Challoner, not Challenger as we printed (1 August).

■ The resolution to change the planetary status of Pluto when it passes over Illinois's skies was proposed and passed by the Illinois State Senate, not the state's one governor (25 July, p 44).

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Last chance to live together

Over 20 years ago, Douglas Adams, author of *The Hitchhiker's Guide to the Galaxy*, and zoologist Mark Carwardine travelled the world to find its most endangered species. Now Adams's friend **Stephen Fry** has retraced his steps for a TV documentary. **David Cohen** meets the comedian, techno-geek and accidental environmentalist to talk about extinctions and iPhones

You're not known for being interested in ecology. So what got you interested in wildlife? That's true. I was never a bug hunter or a collector but I have always been curious about wildlife. This series is all down to Douglas: I house-sat for him in the year he and Mark Carwardine went travelling to research *Last Chance to See*, the book it's named after.

Then Douglas's brother got in touch [Douglas Adams died in 2001]. It was nearly 25 years since Douglas and Mark had decided on their first visit to Nosy Mangabe, an island off Madagascar, in search of the aye-aye, which propelled them to write the book. He asked if I thought the BBC would be interested in Mark and me revisiting the same places to see what had happened. After a lot of hard work, here we are.

Had things got worse since Adams's visit?

Each place has its own unique problems. In Madagascar a slash-and-burn policy over the past 60 years has devastated four-fifths of one of the most remarkable forests there ever was. That is what threatens the lemur population in Madagascar, as opposed to the [central African] northern white rhino, now extinct in the wild, which has more to do with poaching and the cross-border incursions of whatever war is going on.

Did anything fire you up in particular?

The problem of the oceans. So many species of fish are in such appalling danger. I won't have children, but I'll have nephews and nieces, and great-nephews and nieces, and I can't see how they will ever eat a fish. They may see one in an aquarium, but the oceans are being fished out at an appalling rate. It's terrifying.

Did you bone up on the animals before you went, or did you want to be a naive pair of eyes? Naive, but not in a disingenuous way. I'm not trying to be another David Attenborough.

I have a sticky memory so I tend to remember things even though I haven't experienced them. So I couldn't pretend I'd never heard of a pangolin or didn't know what "pelagic" means. But I can ask on behalf of others.

Do you think our efforts at conservation are taking us in the right direction?

The will is there. The problem is that there are people in the natural history world who are not particularly scientific. It's easy to get hung up on your pet species and forget where that species fits into its habitat. Sometimes empiricism can get ditched in favour of a sentimental view. I'm not saying I'm not

"It's not as if we're going to expel man from any country. It's about coexistence"

prone to burst into tears at some sights nature provides: watching turtle hatchlings run into the sea is an extraordinary spectacle that fills one with joy and excitement. I'm not saying one should hold back from an affection for a particular species. I just worry that charities jostle for our attention to push their species at the expense of habitat, which is really the key.

So what should we do?

It's not only the habitat and the animals, but also the humans in that habitat that need to be understood. For example, you can't tell people in Borneo not to cut rainforest or plant palm oil trees unless you also address the issues of population, poverty and the whole nature of the economies of developing countries.

Did the journey change you in any way?

Take the spectacled bears, *Tremarctos ornatus*, that I visited in South America for a different TV series a few years ago. Now, if I was to visit them again I would try to understand the

hill farmers in the cloud forest in Peru and Ecuador, rather than just saying, "Let's rescue these bears." It's not as if we're going to expel man from any country. It's about coexistence.

Do you want to inspire people to follow you?

Let's not be cute about it: if people don't go to Uganda then the gorillas will die. Because of the vagaries of television I have a voice. I have half-a-million Twitter followers and a website with a million unique visitors every month, and I guess that has an influence. Tourism is not the enemy – in most places it's part of the solution. Let's not get all righteous about climate change and say that just because you like travelling the world you are a hypocrite. Take the example of the mountain gorillas. There are only a few hundred of them left: the only way of paying for the mountain rangers to keep them alive is for people to go to Bwindi Impenetrable Forest in Uganda and see them.

You have a phenomenal following on Twitter, and you're famous for being a bit of a gadget fiend. Where does your techno-lust come from?

It started a long time ago. I had early computers: the Sinclairs and then a BBC Micro, which I liked. Then I was the second person in Europe to have an Apple Mac, after Douglas – who was the first. I was on the internet in the late 1980s when it was a world of WAIS and FTP and Gopher, but obviously no web. Then when the Mosaic web browser came out in 1993 I built a website. I won the Lipton Ice Tea cool website award in 1996. In 1997 I wrote the

PROFILE

British actor, writer and TV personality Stephen Fry studied English literature at the University of Cambridge, where he joined the Footlights acting group. His *Last Chance to See* television series will be broadcast in the UK by the BBC this autumn (see www.bbc.co.uk/lastchancetosee).



Not part of a new comedy routine, but a puppet used to help feed takahe chicks in New Zealand

occasional speech for Tony Blair, and Peter Mandelson [then Labour Party election campaign director] came to stay with me and I showed him his first website. Blair was about to make a speech about “access to computers for every child”, but they had absolutely no idea about the web and computers.

I see you have an iPhone...

It's unbelievable. I wrote in a blog that I have never seen a smartphone I haven't bought. I have cupboards and cupboards of them. I particularly love the convergence of wireless technologies in smartphones: GSM, HSDPA, Wi-Fi and Bluetooth. It's amazing, but we're nowhere near perfection yet.

In the 1960s the clever chaps who went on to work at PARC [Xerox's Palo Alto Research Center in California] posited a thing called the Dynabook. It was a sort of Platonic ideal of what a device could be, an all-in-one device that you could interface with in whatever way you wanted. It was your source of literature, communication, art and music. The iPhone is the closest we've come to that so far.

Is the time we're all spending online or with our gadgets taking us away from nature?

Yes, but it's not the case that everyone just sits in front of a computer. They do both. It's equally a pity if someone just goes on nature rambles and never tries to play a computer game. They are missing out on what it's about to be alive now. You don't have to like it, but you might try it out. These technologies are phenomena we barely understand in terms of their social impact. To characterise it as people shutting off from the world and sneering at them is a gross disservice to the technology, but more importantly to the people who use it.

Can humans and technology coexist happily?

I admit the change is strong and may seem bewildering, and it probably should seem bewildering. It's a bit like what Niels Bohr said about quantum mechanics: “If you're not shocked by it, you don't understand it.” If we're not shocked by the way our world is changing, then we probably haven't grasped how much it's changing. Taking a view that technology somehow muffles the human spirit is like saying that concrete is bad because it destroys grass. Anyone who's seen a pavement knows that grass can push up through concrete. The human spirit is the same – it can push up through any amount of sealing-off. ■

MARK CARWARDINE

Have telescopes spied out the quantum fabric of the universe?

Anil Ananthaswamy investigates



The
light
that came
late



ON THE night of 30 June 2005, the sky high above La Palma in Spain's Canary Islands crackled with streaks of blue light too faint for humans to see. Atop the Roque de los Muchachos, the highest point of the island, though, a powerful magic eye was waiting and watching.

MAGIC – the Major Atmospheric Gamma-ray Imaging Cherenkov Telescope – scans the sky each night for high-energy photons from the distant cosmos. Most nights, nothing remarkable comes. But every now and again, a brief flash of energetic light bears witness to the violent convulsions of a faraway galaxy.

What MAGIC saw on that balmy June night came like a bolt from the blue. That is because something truly astounding may have been encoded in that fleeting Atlantic glow: evidence that the fabric of space-time is not silky smooth as Einstein and many others have presumed, but rough, turbulent and fundamentally grainy stuff.

It is an audacious claim that, if verified, would put us squarely on the road to a quantum theory of gravity and on towards the long-elusive “theory of everything”. If it were based on a single chunk of MAGIC data, it might easily be dismissed as a midsummer night's dream. But it is not. Since that first sighting, other telescopes have started to see similar patterns. Is this a physics revolution through the barrel of a telescope?

Such incendiary thoughts were far away from Robert Wagner's mind when the MAGIC data filtered through to the Max Planck Institute of Physics in Munich, Germany, the morning after. He and his fellow collaborators were enjoying a barbecue. Not for long. “We put our beers aside and started downloading the full data set,” says Wagner.

It was easy to pinpoint the source of the data blip – a 20-minute burst of hugely energetic gamma rays from a galaxy some 500 million light years away known as Markarian 501. Its occasional tempestuous outbursts had already made it familiar to gamma-ray telescopes worldwide.

This burst was different. As Wagner and his colleagues analysed the data in the weeks and months that followed, an odd pattern emerged. Lower-energy photons from Markarian 501 had outpaced their higher-energy counterparts, arriving up to 4 minutes

earlier (*Physics Letters B*, vol 668, p 253).

This should not happen. If an object is 500 million light years away, light from it always takes 500 million years to get to us, no more, no less. Whatever their energy, photons always travel at the same speed, the implacable cosmic speed limit: the speed of light.

Perhaps the anomaly has a mundane explanation. We do not really understand the processes within objects such as Markarian 501 that accelerate particles to phenomenal energies and catapult them towards us. They are thought ultimately to have something to do with the convulsions of supermassive black holes at the objects' hearts. It could be that these mechanisms naturally spew out low-energy particles before high-energy ones.

Or they might not. “The more fascinating explanation would be that this delay is not intrinsic to the source, but that it happens along the way from the source to us,” says Wagner.

Quantum signature

What piqued the interest of Wagner and his colleagues was that the MAGIC observations were showing just the sort of effect that quite a few models of quantum gravity predict. Physicists have been on the lookout for experimental signposts to the right theory for the best part of a century (see “Quantum gravity: why we care”, page 28).

“All approaches to quantum gravity, in their own very different ways, agree that empty space is not so empty after all,” says theorist Giovanni Amelino-Camelia of Sapienza University of Rome in Italy. Many models based on string theory suggest that space-time is a foamy froth of particles, and even microscopic black holes, that spark up out of nothing and disappear again with equal abandon. The alternative approach favoured by Amelino-Camelia, loop quantum gravity, posits that space-time comes in indivisible chunks of about 10^{-33} metres, a size known as the Planck length.

Last year, it was suggested that the signature of just such a quantum space-time had popped up in unexplained noise plaguing a gravitational-wave detector in northern Germany (*New Scientist*, 17 January 2009, p 24). But that interpretation is far from a done deal, and most experts agree that a more substantive sighting could only come from observing the possible interactions of space-time with particles passing through it.

According to many string theory models, ➤



Was this MAGIC eye the first to spot quantum space-time?

"Physicists have been on the lookout for signposts to the right theory of quantum gravity for the best part of a century"

particles of different energies should speed up or slow down by different amounts as they interact with a foamy space-time. A minimum size for space-time grains, as predicted by loop quantum gravity, could violate the cherished principle of special relativity known as Lorentz invariance, which states that the maximum speed of all particles, regardless of their energy, is the speed of light in a vacuum.

The trouble is that these effects would be observable only with particles far more energetic than even the beefiest terrestrial particle accelerators can produce. Even if we could make these particles, the tiny interactions between them and the fabric of space-time would not add up to a hill of beans, even over many laps of the Large Hadron Collider's 27-kilometre-long loop at CERN, near Geneva, Switzerland.

Summed over hundreds of millions or billions of light years, such interactions could account for the MAGIC travel-time anomaly. It looks like nature might have provided us with particle accelerators – distant galaxies – whose products could, for the first time, allow us to test predictions of quantum gravity against hard experimental evidence.

As yet, we have only seen a handful of gamma-ray bursts of the energy and intensity needed to see whether the delay effect is a consistent feature. In July 2006, the High Energy Stereoscopic System (HESS), an array of gamma-ray telescopes in the desert of Namibia, saw a high-energy flare erupt from an active galaxy nearly four times as far away as Markarian 501. The burst contained marginal evidence for a time-lag of around

half a minute for the most energetic photons, which were considerably less energetic than those in the flare spotted by MAGIC. The uncertainties in the data resulting from the detection process, however, made a definitive statement impossible (*Physical Review Letters*, vol 101, p 170402).

It is recent results from NASA's Fermi Gamma-ray Space Telescope, launched last year, that provide the most tantalising glimpse yet of something extraordinary going on out there. Last September, it spied a burst of gamma rays from a source nearly 12 billion light years away. According to an analysis by Amelino-Camelia and Lee Smolin of the Perimeter Institute for Theoretical Physics in Waterloo, Canada, the zippiest low-energy photons beat some of the high-energy stragglers to Earth by anything up to 20 minutes. Two much closer bursts seem to contain much smaller delays (www.arxiv.org/abs/0906.3731v2).

The individual observations are pretty consistent with each other, too, says theorist John Ellis at CERN. He and colleagues have taken data from the MAGIC and HESS bursts to calibrate a theoretical model inspired by string theory that assumes the delay effect increases linearly with distance and photon energy. Using it to estimate the delay that the highest-energy photon in the Fermi space telescope's September burst should have experienced, they came up with a figure of 25 seconds, plus or minus 11 seconds. What Fermi had measured for that particular photon was 16.5 seconds – within the model prediction's admittedly large margin of error.

The only way to find out conclusively

whether the delays are a consistent signature of a quantised or foam-like space-time, says Ellis, is to get more data – ideally from sources at many different distances. "Then we'll be able to see whether we can distinguish between effects at the source and effects in the propagation," he says.

Worldwide cover

We also need to observe the same burst with more than one instrument. Each telescope is sensitive to a different energy range, owing to its altitude and detector set-up. Combining different data sets will provide a wider spread of energies from which to tease out any energy-dependent effect, and also help us get round a persistent irritant to consistent astronomical observations: Earth's rotation. Not only does our planet's spin mean that multitudes of photons from the sun overwhelm any cosmic source for a large proportion of the day, but it also makes observing a highly directed beam of gamma rays from one specific direction tricky, even at night: as you train your telescope on your target, the Earth moves beneath your feet and eventually the source slips out of sight.

That means MAGIC can observe any burst for a maximum of only 6 hours on any given night, assuming it is pointing in the right direction when a new burst arrives. That period could be doubled by using it in conjunction with a similar instrument – the Very Energetic Radiation Imaging Telescope Array System (VERITAS) – that sits atop Mount Hopkins in southern Arizona.

A further gamma-ray telescope, the Major

Quantum gravity: why we care

On the scale of profound things in physics, quantum gravity scores an easy 10 out of 10. Currently, three of the four fundamental forces of nature can be explained by the exchange of force-carrying particles that follow the rules of quantum theory. Gravity cannot. According to Einstein's general theory of relativity, the force arises from the smooth warping of space-time by massive objects. As such, it remains resolutely outside the purview of quantum physics.

That must change, physicists agree. Without a quantum theory of gravity, we not only lack an overarching theory of

the workings of the world, but we are also never going to be able to probe back to the first tiny fractions of a second after the big bang – a crucial and eventful period in the evolution of the universe.

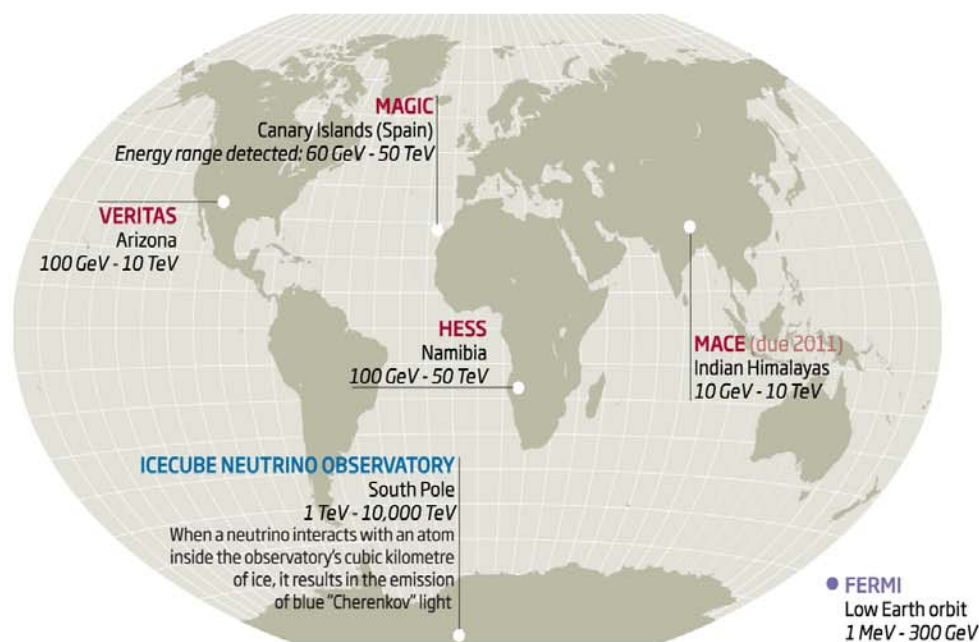
The trouble is, there is no agreement on how to get to that theory. String theory, the avenue preferred by most physicists, melds gravity and quantum mechanics by arguing that everything in nature arises from the vibration of tiny strings in 10-dimensional space-time. It has been roundly criticised, though, for failing to come up with any prediction that experiments might verify. A rival

approach, called loop quantum gravity, shows mathematically that space-time is woven out of loops of gravitational field lines. In the evidence stakes, it has fared no better.

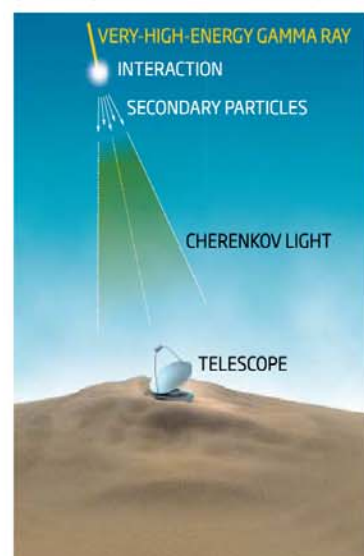
"For many decades, research on quantum gravity was being monopolised by the idea that we needed to get a perfect theory, with geniuses producing perfect mathematics, and with no guidance from experiments," says Giovanni Amelino-Camelia of Sapienza University of Rome in Italy. The geniuses desperately need something to tether their models to reality. For that, they could do with a touch of MAGIC (see main story).

All eyes on space

On completion of the MACE detector in 2011, four terrestrial telescopes - supplemented by the Fermi space telescope - will give nearly 24-hour coverage of high-energy cosmic gamma-ray sources across a wide energy range



HESS, MAGIC, VERITAS and MACE detect gamma rays indirectly through the cone of secondary "Cherenkov" light emitted when gamma rays hit atoms in Earth's atmosphere



FERMI uses a more direct detection method, making it more accurate and sensitive to gamma rays of lower energies

Atmospheric Cherenkov Telescope Experiment (MACE), 4500 metres up on the Tibetan plateau in the remote region of Ladakh, India, will open that observational window still further. When completed in 2011, MACE will be the highest-altitude gamma-ray telescope in the world, capable of observing gamma rays with a wide range of energies. "Then we will have another observatory 5 to 6 hours in front of MAGIC," says Wagner. "That could lead the way to a continuous, 24-hour observation of certain objects."

What with that and the new high-accuracy data from the Fermi space telescope, gamma ray telescopes could well uncover quantum space-time within the next few years. Even so, they still might be beaten to the line. The definitive answer might come from a very different source, and a very different quarter of Earth's surface - the South Pole.

That is because a cubic kilometre of ice under the South Pole will soon be home to the IceCube Neutrino Observatory, whose strings of detectors will watch for faint flashes of blue light emitted when neutrinos from cosmic sources smash into the Antarctic ice.

Neutrinos are ghostly particles thought to be produced in the same violent events that produce high-energy gamma rays. As yet, we have not seen any neutrinos from outside our galaxy, barring some that burst on us from a supernova in a neighbouring galaxy, the Large Magellanic Cloud, in 1987. The neutrinos we do see are lower-energy ones that come from nuclear reactions in the sun and particle interactions in Earth's atmosphere. IceCube aims to change that.

And it could see something big. Because the quantum-mechanical wavelengths associated with neutrinos of the very highest energies are even smaller than those of high-energy photons, they could be more susceptible to disruption through interactions with a space-time that is grainy on very small scales. Francis Halzen of the University of Wisconsin, Madison, who leads the IceCube experiment, has calculated together with his colleagues that in one favoured model of quantum space-time such interactions could dramatically speed up higher-energy neutrinos (*Physical Review D*, vol 72, p 065019). "It's a beautiful signal that could not be explained by conventional astrophysics," he says.

Humble constructions

That's not the only attractive property of neutrinos when it comes to testing the idea of a frothy space-time, says Dan Hooper of Fermilab in Batavia, Illinois. Neutrinos come in three distinct "flavours", named after the chunkier particles they are associated with - the electron, the muon and the tau. They tend to morph back and forth between these different states as they travel, a phenomenon known as neutrino oscillation. If a distant source is emitting only electron neutrinos, theory tells us how many should have changed flavours by the time they reach us.

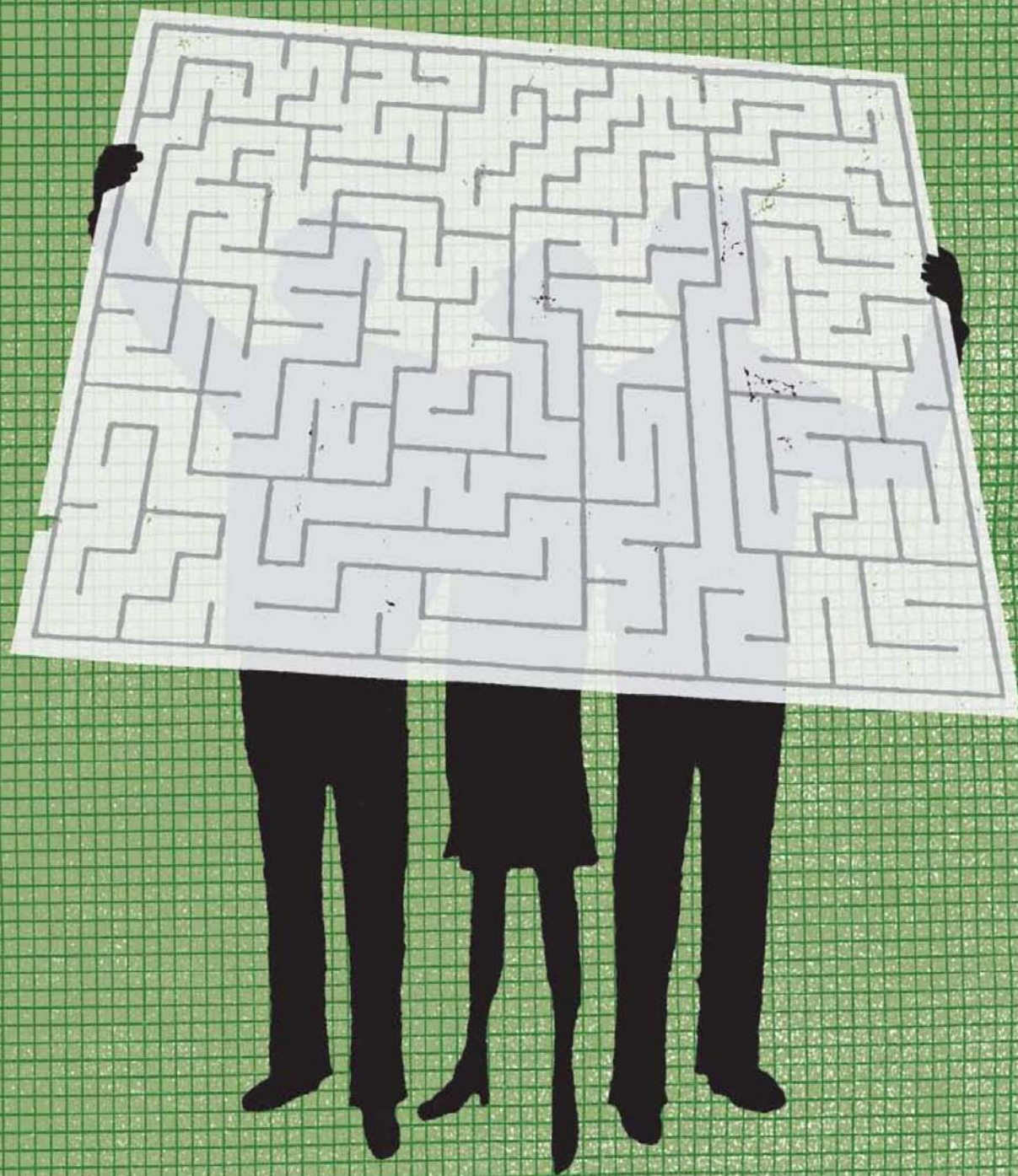
If neutrinos were interacting with the quantum foam, though, they would forget their original flavour along the way, leading to equal numbers of all flavours by the time they arrive here. "That effect would be hard to

explain with normal astrophysics," says Hooper. He suggests a possible, albeit disputed, source of electron neutrinos in the Cygnus region of the Milky Way that could be ripe for investigation (*Physics Letters B*, vol 609, p 206).

Uncertainties in models of neutrino oscillations make exact calculations of the expected extent of the flavour-equalising effect difficult, as Hooper himself points out. And even if we do strike it lucky and find indisputable signs that either neutrinos or gamma rays are being affected by the structure of space-time, it will be a long, hard slog to convert that evidence into a viable theory of quantum gravity. Amelino-Camelia likens the situation now to that of a century ago, when anomalous observations - such as the spectrum of black-body radiation, or the photoelectric effect - that could not be explained by classical means set physics on the decades-long path towards a fully fledged quantum theory. It did not come easy.

And so it will be for quantum gravity. "We have to build, humbly, very humbly, from what we know," says Amelino-Camelia. "Construct simple theories, which are very far from being a theory of everything, but intelligible enough that they can guide us to the next spark." Whether on Atlantic islands, in the Himalayas, deep in the Antarctic ice or high above Earth's atmosphere, watchful eyes are waiting for signs from the universe's quantum fabric. ■

Anil Ananthaswamy is a corresponding editor for *New Scientist*



Birds, rats and even hamsters are able to find their way around with consummate ease. So how come we can't navigate our way out of a paper bag? Chris Berdik gets his compass out...

Lost

THE journey seemed simple enough, on the map anyway. Allison Fine left her home to drive to Vermont, just a few hours north on a major highway. She had studied the route and had a GPS gadget to help her. Nevertheless, she soon had absolutely no idea where she was.

"I don't know what happened," she says, "but I pulled over in tears, called my husband and said, 'find me on Google Maps and talk me to Vermont.'" This he did, staying on the line for more than an hour.

Fine is an extreme case, but the feeling of getting hopelessly lost is something that most of us can relate to. In fact, along with our flair for language and our unparalleled intelligence, less-than-stellar navigational skills are among the things that can be considered uniquely human. While the vast majority of animals have no trouble finding their way around, most people, when stripped of maps or signs, are notoriously bad at it. A handful are so terrible at orienting themselves, even in places they know well, that they rarely leave the house alone (see "Lost in space", page 32). "I try to study maps," says Fine. "But when I get out into the real world, it just looks completely different."

Until recently, little was known about how the human inner compass works. This is partly because "sense of direction" is not one neatly defined ability. Instead, it is made up of many different skills, such as awareness and memory of your surroundings, sensing your speed and direction changes over time, and

tracking the location of objects and places relative to you as you move through an environment. These skills rely on many different parts of the brain, including those involved in vision, memory and imagination, which are tied together into a "cognitive map" by the hippocampus.

Now researchers have begun to unravel how this system works, and to ponder whether we have lost our way somewhere in evolution, or whether our inner homing pigeon is simply lying dormant, waiting to be released.

The first person to explore the idea of a cognitive map – a mental representation of an individual's physical surroundings – was Edward Tolman, a psychologist at the University of California, Berkeley, in 1948. Tolman observed that rats could take novel routes to food hidden in a maze when their learned route was blocked or they were moved to a new starting point. Since then, countless other species have shown an impressive talent for keeping track of where they are.

Take golden hamsters. They can make a straight dash for home even after being blindfolded and led in a winding path away from their nests. Similar skills have also been observed in geese, toads and spiders. ➤

"Have we lost our way somewhere in evolution or is our inner homing pigeon simply lying dormant?"

"Some people are so prone to getting lost that they fear leaving the house alone"

Equivalent tests with people, however, have seen our species come up seriously short. In "triangle completion" tasks, researchers lead people, either blindfolded or in a landmark-free virtual-reality environment, along two sides of a triangle and then tell them to find their way back to the starting point. In one such study, Jack Loomis, a cognitive psychologist at the University of California, Santa Barbara, found that the average error on the final turn was 24 degrees and most people significantly under or overshot the distance. As Loomis summed up: "None of the subjects exhibited good performance."

This weak innate ability to judge distance

and direction makes for some pretty squishy mental maps, says William Warren, a cognitive neuroscientist at Brown University in Providence, Rhode Island. He fitted volunteers with virtual-reality headsets and showed them how to navigate virtual mazes. In half of the experiments, the mazes contained virtual, and invisible, "wormholes" that transported subjects close to a target that they would have known was some distance and a turn or two away. Yet the volunteers happily passed through these shortcuts to end up at a point that even a halfway-decent geometric reckoning would have told them was impossible. "The punchline," Warren says, "is that people didn't even notice anything amiss."

These findings, presented at this year's Vision Science Society conference in Naples, Florida, suggest that human cognitive maps pay little heed to geometric realities. Instead, we remember webs of landmarks such as the store, our office, the church where we turn left on our way home, yet have little sense of how these fit together spatially.

Of course, some species find their way with the aid of specialised senses that we simply do not possess. Migratory birds can sense the Earth's magnetic field, for example, while some insects can see gradations in the polarity of sunlight. Yet even animals that lack any huge sensory advantage, such as hamsters, navigate better than many of us.

In a series of recent studies, Michael Kahana and his colleagues at the University of Pennsylvania in Philadelphia studied the brains of epileptic people, who already had electrodes implanted in their brains, as they played a taxi-driving video game. By noting which neurons fired when, the researchers discovered that human brains have specialised neurons dedicated to sense of direction, similar to those found in the hippocampus of rats, mice, monkeys and goldfish. So why can't we compute geometric space in the same way?

Losing our way

It could be that we lost this ability at some point in our evolution, sacrificing the kind of precision that other animals enjoy in return for cognitive flexibility, which allows us to make sense of our surroundings and find our way using reasoning and experience rather than geometry.

Indeed, studies of people that live closest to the land, such as the Bedouin in the Sahara, Arctic Inuit and Australian Aborigines, show

Lost in space

Every so often, Sharon Roseman rounds a bend in her suburban Colorado neighbourhood and drives into a new world. It's a lot like the world she knows - same houses, same street names - but with one critical, maddening difference: everything in it has shifted 90 degrees. Familiar stores at well-known intersections are not where she feels they should be, and the Rocky mountains have migrated from the north to the east.

Roseman's world has been turning like this since she was 5 years old, and the only sure-fire way to set things right is to close her eyes and spin until everything "clicks" back into place, a remedy she jokingly calls her "Wonder Woman cure". Despite countless visits to a doctor, prescriptions and brain scans over more than 50 years, nobody has offered a diagnosis. Nobody, Roseman suspects, really believed her. Until now.

Giuseppe Iaria of the University of Calgary, Alberta, and Jason Barton at the University of British Columbia in Vancouver, both in Canada, may have finally put a name to Roseman's condition. They call it developmental topographical disorientation. While people with the disorder have no obvious brain injury or other cognitive problem, they are chronically unable to orient themselves, even in places they know well. The pair have found 400 or so people who may have the disorder, some of whom are so prone to getting

lost they fear leaving the house alone.

In a paper published earlier this year, Iaria and Barton used real-world navigation tasks, map sketching and brain scans to document the case of "Patient One", a middle-aged woman in Vancouver who routinely gets lost, even in familiar environments (*Neuropsychologia*, vol 47, p 30). They found that Patient One had normal cognitive abilities, no brain damage, lesions or dyslexia, and no problems with memory, balance or visual perception.

In tests, she could follow a route by memorising a list of directions, says Iaria, but she had great difficulty creating an accurate mental representation of her environment. Drawing maps totally flummoxed her and she took three times as long as control subjects to come up with an accurate shortcut after learning the location of four landmarks in a virtual city.

Functional magnetic resonance images of her brain revealed that her hippocampus and retrosplenial cortex - areas that are activated in typical human brains as they form a cognitive map - showed no spike in activity as she tried to imagine a route. The researchers are now investigating the possibility that there may be a common developmental defect in the hippocampus that leaves some people chronically lost.

To test your own navigation skills or volunteer for Iaria and Barton's study visit www.gettinglost.ca/Test.html.

Show me the way to go home

In 1986, Kenneth Hill, a psychologist at Saint Mary's University in Halifax, Nova Scotia, Canada, joined thousands of volunteers searching for a 9-year-old boy lost in the Nova Scotia wilderness. After more than a week, they found the boy's body less than 3 kilometres from where he was last seen. Since then, Hill has focused his career on the study of how people behave when they are lost in the wild, in a bid to predict where people will turn up.

He has found that children under 7 years of age have the highest survival rates, because they do not build a mental map that might trigger counterproductive efforts to get reoriented. "Most of the time they just wander around for a while, and then they get cold and look for warmth," says Hill. Instead, it is people

who believe they have a strong sense of direction that get into the most trouble. Some have been known to dismiss visual clues and even distrust a compass if it contradicts their mental map.

Search and rescue professionals have begun to use a similar approach. Rick Toman, director of search and rescue for the state of Massachusetts, uses a computer model that includes common trends among different types of people to inform the search. Autistic children are often fascinated by water, for example, so it pays to look near rivers and lakes, while suicidal people prefer elevated spots with good views. Missing married men are often easier to find, says Toman. They tend to turn up at a motel "with somebody they shouldn't be with".

to, other studies indicate that for some of us, substantial improvements may be impossible.

In 2006, Daniel Montello and Toru Ishikawa at the University of California, Santa Barbara, taught 24 people two landmark-studded routes which were connected by a winding but landmark-free route in 10 weekly sessions. After each session, they asked participants to point from one landmark to the others, which were always out of sight, and draw maps of the routes.

Three clear groups emerged: one that kept doing well throughout the experiment, one that did poorly from beginning to end and one that was intermediate. This final group was the largest, and the volunteers within it all improved at the tasks as the experiment progressed, although only one-third of this group became as good as the top performers (*Cognitive Psychology*, vol 52, p 93).

To Thomas Wolbers, a neuroscientist at the University of Edinburgh, UK, findings like these point to a genetic component to navigation ability. Several studies have found signs of such a link in rodents, and Wolbers is currently looking for similar evidence in a sample of 50,000 people. He expects to get initial findings in about a year.

Regardless of whether all or just some of us are a navigational lost cause, psychologist

How to find your way

...and what to do if you lose it

DO

- Retrace your steps
- Climb a hill or tree to get a better view of your surroundings
- Stop and look behind you regularly, so you recognise the route in both directions
- Pay attention to the position of the sun and landmarks
- Take a GPS device and several compasses
- Memorise your route by making up stories about the landscape as you pass through it
- If truly lost, find shelter and stay put - you are more likely to be found

DON'T

- Panic - you may miss or forget important signs
- Follow a stream assuming it will lead to civilisation. It will just as likely lead to a bug-infested swamp
- Strike out in a totally new direction - you are less likely to be found
- Rely too heavily on your mental map. Back it up with a compass reading or two and the map in your pocket

Sources: Kenneth Hill, Saint Mary's University in Halifax, and Colin Ellard's *You Are Here: Why we can find our way to the moon but get lost in the mall* (2009, Doubleday)

that reasoning and experience can be very useful for finding your way. Such people can navigate perfectly well using subtle, learned directional cues from the landscape, even in what looks like the most barren expanse of snow or desert. Trading a mental tally of distance and direction for real understanding of the landscape in this way may have given us an evolutionary boost.

The trouble is, unlike an innate computation of distance and directional change, this connection to the landscape is all too easy to distort or lose entirely. Claudio Aporta, an anthropologist at Carleton University in Ottawa, Ontario, Canada, has observed how young Inuit hunters, who have begun to rely on GPS to navigate, have found themselves hopelessly lost for days when the technology fails, leading to several fatal and near-fatal incidents (*Current Anthropology*, vol 46, p 729). This was unheard of among the elders - until recently, the Inuit didn't even have a term for being lost. "It was just a matter of time before the weather cleared or they recognised a feature on the land and they would find their way," says Aporta.

That these skills are so easily lost could explain why the average westerner struggles to navigate without help. Most people now live in a world that has been made navigable by maps, street signs, transport networks and GPS. There is no need to understand the environment to get around.

Yet while these findings seem to show that we could all navigate like a Bedouin if we had

"Losing our relationship with physical space may have allowed us to create a reality of our own"

Colin Ellard at the University of Waterloo in Ontario, author of *You Are Here*, argues that there is an upside to our lack of natural navigation skills. He suggests that losing our relationship with physical space, coupled with the unique human ability to imagine ourselves in another location, may have given us the freedom to create a reality of our own. What other species could comprehend the World Wide Web or contemplate exploring new worlds, he asks.

And while we may struggle to find our way back to the car after a shopping trip, we can take heart in the knowledge that, as a species, we have managed to find our way to the moon and back, and have sent satellites to just the right orbit so that we no longer need to think about where we are going. Show me a hamster that can do that. ■

Chris Berdik is a science writer based in Boston

A spate of innovation is about to transform the diesel-guzzling kings of the road - and not a moment too soon, says Phil McKenna

Bad boys clean up



CARRY OWENS/GALLERY STOCK

THESE days our highways seem strewn with the wreckage of a car industry in crisis. Sales of gas-guzzlers have plummeted. Some of the world's largest car-makers have all but gone to the wall. In the US, for the first time in a quarter of a century, the nation's favourite SUV has been outsold by a passenger car – a Japanese compact at that. No, life on the road ain't what it used to be.

So what of those kings of the road – the heavy trucks that move some 70 per cent of all freight in the US and a similar slice in the UK and much of Europe? With the global economy in recession, fuel prices still high and ever-tighter emissions laws ahead, you might imagine that they too would be heading at full tilt towards an economical, low-carbon future. You'd be wrong. "The truck industry has been stagnant for a very long time," says energy-efficiency advocate Amory Lovins of the Rocky Mountain Institute (RMI) in Colorado.

While the average fuel efficiency of the US car fleet has almost doubled in the last 40 years, today's heavy trucks guzzle the same amount of fuel – roughly 30 litres per 100 kilometres – as they did in 1969 (see graph, p 36). In 1990, America's truckers burned the equivalent of 1.6 million barrels (254 million litres) of oil per day, about 10 per cent of the nation's total consumption. By 2007, this had risen to 2.5 million barrels.

This cannot go on, and truck-makers, freight companies and transport researchers are finally getting the message. Across the world, and especially in the US, they are taking a new look at ways to cut freight fleets' fuel consumption.

Even small improvements can bring big benefits. A concept vehicle called the Innovation Truck unveiled in April by Daimler

"Today's heavy trucks guzzle the same amount of fuel that they did four decades ago"

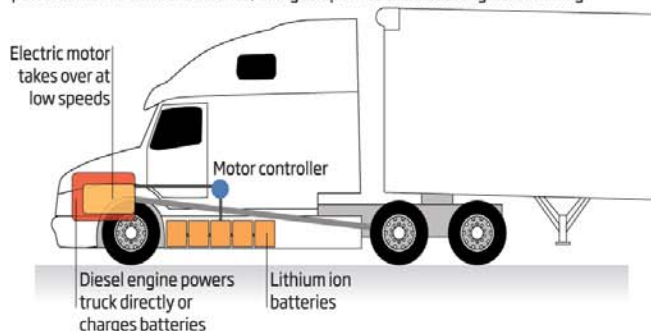
Trucks North America is designed to show what is possible by tweaking a vehicle's aerodynamics. In wind tunnel tests it used 3 per cent less fuel than an unmodified truck – which rolled out across the entire US truck fleet would save about 4.3 billion litres of fuel annually. This translates into an annual cut in CO₂ emissions of over 11 million tonnes.

More ambitious plans are afoot. Engineers and industry leaders at an RMI conference on freight-vehicle efficiency in April concluded that readily available and inexpensive technologies could boost efficiency by up to 23 per cent, and even doubling or tripling fuel efficiency might be within reach.

It has been half a century since the truck industry started experimenting with

20% Potential fuel savings

Dual-powered (hybrid) vehicles are driven by a traditional diesel engine or an electric motor powered from a bank of batteries, charged up while the diesel engine is running



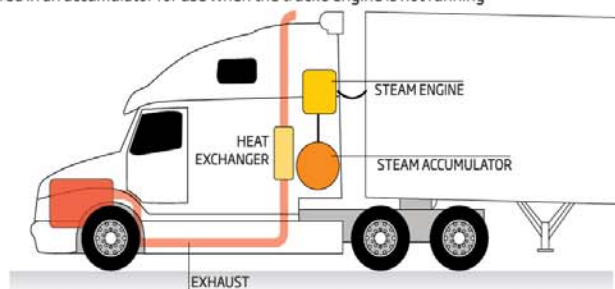
Electric juggernauts

Petrol-electric hybrid cars have been around for years, saving their owners around 20 per cent at the pump, yet the technology has been slow to catch on in trucks. Even in the US, which ranks as a world leader in hybrid trucks, only about 1000 are on the road – and these aren't big rigs but mid-sized delivery vehicles. In fact they mostly aren't even full hybrids at all, but "power assist" hybrids. Most of the time, these trucks are powered by a conventional diesel engine and the electric motors just kick in to boost the power when needed.

Things took a step forward early this year when ArvinMeritor – whose main business is producing components and systems for truck manufacturers – unveiled a genuine diesel-electric hybrid long-haul truck, which can run solely on electric power at up to 75 kilometres per hour. It is expected to cut fuel use by up to 15 per cent on long journeys and 25 per cent in city traffic. It is being road-tested by the retailer Wal-Mart.

40% Potential fuel savings

Waste heat from the diesel exhaust creates steam that feeds a secondary engine, which can be used to boost the truck's power or run its cargo-area refrigerator. The steam can be stored in an accumulator for use when the truck's engine is not running



Cool running

Capturing the waste heat from the engine and using it to help power the truck is a sure-fire way to save fuel. Heat-recycling technologies that increase engine efficiency by 5 per cent will be on the road within the next five years, according Haoran Hu of engine technology company Eaton Corporation in Cleveland, Ohio. Efficiency improvements of up to 20 per cent are possible, he says, though they are more costly. Engineers are testing a variety of new thermoelectric materials capable of converting heat directly to electricity.

UK-based Clean Power Technologies (CPT) has developed a system that uses waste heat to generate steam. This is stored in an accumulator and used when required to help drive the engine itself, or to power auxiliary equipment such as the cooler of a refrigerated container. The technology is being tested by engine manufacturer Voith Turbo based in Heidenheim, Germany. CPT claims a 40 per cent increase in fuel efficiency, and is about to begin road tests with two Canadian freight companies.

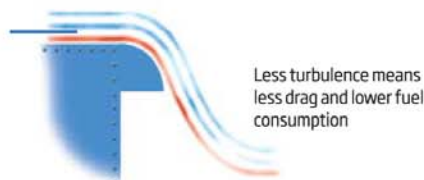
11% Potential fuel savings



Square ends leave trails of drag-inducing turbulence in their wake



Blow a gentle jet of air from a slot onto a curved surface and it smooths airflow, reducing the turbulence



more efficient designs, and steady improvements to engines and modest aerodynamic advances have followed in the years since. Unfortunately, the gains have been undone by other factors that have increased fuel consumption, such as higher speeds, traffic congestion and excessive product packaging, which has cut the effective capacity of each truck. Meanwhile the cargo trailer – the box-on-wheels that is pulled by the tractor – has been virtually ignored. “It’s a dumb asset, and it has to get smarter than that,” says Bill Van Amburg of Calstart, a low-energy-transportation consultancy in Pasadena, California.

Yet there are ways of streamlining trailers. Skirts that cover the wheels and the open space under the trailer, and fairings covering the gap between the tractor and trailer, can improve fuel efficiency by 6 per cent. Rounded flaps or fins on the back of the trailer add a further 6 per cent. And simply blowing air through vents at the rear of the trailer cuts drag by up to 5 per cent (see “Go with the flow”). Wind-tunnel tests confirmed many of these improvements more than half a century ago. So why are they not commonplace?

Part of the problem is that with about four trailers to each tractor in the US, the trailers sit idle most of the time, reducing the payback from any investment aimed at enhancing fuel efficiency. To make matters worse, it’s the company operating the tractor unit that pays the fuel bill, while the trailer may well be owned by someone else. “It’s really a battle between logistics, practicality and cost,” says Ken Howden, director of the 21st Century Truck Partnership, a project to improve truck performance coordinated by the US Department of Energy.

One way around this is to look beyond the hardware for ways to save fuel. Shipping giant UPS uses routeing software that tries to avoid turns across the flow of oncoming traffic (left turns in the US and continental Europe; right

Go with the flow

Turbulent airflow at the rear of a trailer can be a serious drag on fuel economy, and while rounded ends or tail fins can help, they can only improve things by a few per cent. A more radical solution is to combine geometric changes with a technology borrowed from the aerospace industry and surround the rear of the trailer with a stream of smooth air.

Robert Englar and his colleagues at Georgia Tech Research Institute in Atlanta have built a pneumatic system (*New Scientist*, 9 June 2001, p 36) that blows a gentle stream of air out of the rear of a trailer through a series of pipes and

nozzles. This reduces airflow separation along the back of the truck (see diagram, left) that would otherwise create a pocket of turbulence and low pressure behind the vehicle, holding it back.

Tests on a prototype in 2004 found it improved fuel efficiency by 5 per cent, on top of the 6 per cent savings offered by streamlining. Two airflow systems compatible with new and existing trailers have been completed in the past few months, and could retail for as little as \$2000, Englar reckons. The device would pay for itself in about 161,000 kilometres, or less than three years, on average.

Smooth operator

If incremental aerodynamic improvements seem like a lot of effort for a small gain, the superstreamlined concept trucks by German designer Luigi Colani take aerodynamic enhancement to a whole new level.

In 2002 Colani unveiled a tanker truck that proved 41 per cent more fuel efficient than a conventional tanker of the same size. Then in 2007 Colani built a \$1 million prototype “supertruck” that he says travelled 50 per cent further on a gallon of fuel than a conventional truck with the same engine. Colani says that mass-production would make his trucks more affordable.

Less spectacular, but possibly more cost-effective, simply increasing a vehicle’s length can improve efficiency in terms of fuel used per tonne carried. A recent study by the American

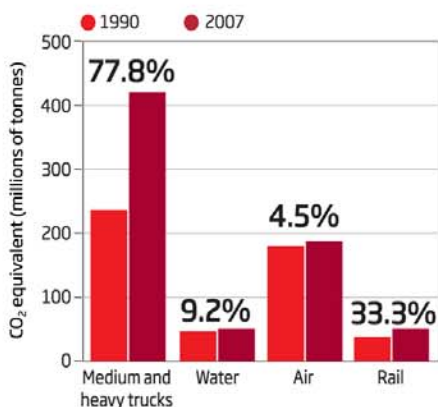
Transportation Research Institute, based in Arlington, Virginia, found that attaching a second full-size trailer to the back of a conventional truck increased efficiency in these terms by up to 36 per cent. So-called “long combination vehicles” made up of four trailers behind a single tractor are allowed in parts of Western Australia. In many US states, even a second trailer is prohibited, as trailer trains can be unstable. Improved trailer design could overcome this objection.

More ambitiously, automated sensors and controls are being planned that allow “caravans” of trucks to form up and drive safely one behind another, with only a narrow gap between vehicles. Japanese researchers are planning highway tests of this technology in 2011. Based on trials by other groups, average fuel savings of 11 per cent per vehicle might be possible.

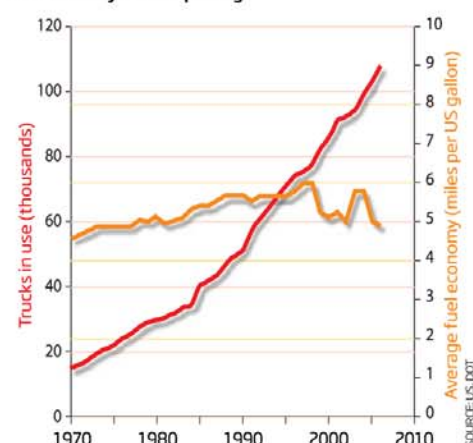
Why trucks need to clean up their act

Trucks account for 12 per cent of the oil consumed in the US, with a corresponding contribution to carbon emissions

Compared to other forms of freight transport, heavy trucks are responsible for the most carbon emissions and the largest percentage increase



There are ever more trucks on US roads, and their fuel economy is not improving

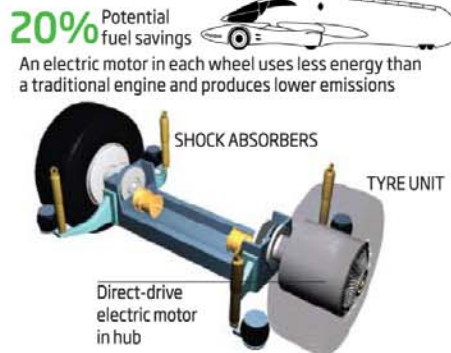
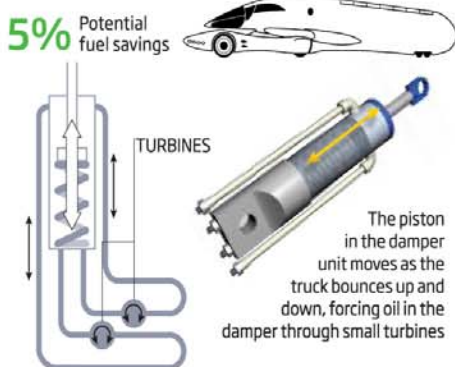


Pothole power

The smooth ride provided by a modern truck's sophisticated suspension comes as a cost: it soaks up a lot of energy. Instead of letting this go to waste as heat, the GenShock system, developed by Levant Power of Boston, captures it and converts it to electricity, with fuel savings of up to 5 per cent.

The key component is a modified shock absorber or damper, which stops the vehicle bouncing after it hits a bump in the road. As in a conventional shock absorber, the suspension linkage connects the wheel to a piston, which is forced through a chamber containing viscous fluid when the wheel hits a bump. In the GenShock system, the motion of the piston forces fluid through a small turbine (see diagram, below) that drives an electrical generator.

The electricity this provides charges the battery, which would otherwise take its power from the vehicle's engine-driven alternator. The rougher the terrain, the more power the shocks produce, but even on smooth highways vibrations in the suspension system of a long-haul truck would generate useful amounts of power: 500 watts per unit, according to Levant Power's tests. The company intends to start pilot tests on commercial trucks this year.



Drive wheel

The days of roaring juggernauts could be numbered. E-Traction, a company based at Apeldoorn in the Netherlands, has developed an electric motor for trucks and buses that fits inside each wheel, putting the power down right where it is needed (see diagram, above). By eliminating the heavy transmission and gearing that soaks up a significant portion of the engine's power in a conventional truck, this delivers impressive efficiency savings. "We kick out all the mechanical parts," says Arjan Heinen of E-Traction. "There is only one moving part: the wheel itself."

E-Traction wheels have been working in experimental buses since 2005. Trials in the first freight vehicle, a 7.5-tonne diesel-electric hybrid, began last year. The truck, assembled by Dutch start-up Hytruck, has a diesel generator that charges a bank of batteries, which in turn supply electricity for two motors, one in each rear wheel. The truck can go 40 per cent further on a litre of fuel than a conventional truck, and the E-traction wheel power provides a 10 to 15 per cent improvement over hybrids without in-wheel motors. The company plans to produce 10 of these delivery trucks next year and begin production of a 36-tonne hybrid truck in 2012.

"Readily available and inexpensive technologies could double or triple fuel efficiency"

turns in the UK and Australia) to cut down time spent idling. The company says that this and other tweaks to routeing saved it 11 million litres of fuel in 2007 in the US alone.

US superstore Wal-Mart, which maintains the country's largest trucking fleet, claims to have done even better, with gains of more than 25 per cent helped by smart routeing software and keeping the packaging of its products to a minimum. With more measures like this, the company says it aims to double its fleet's fuel efficiency by 2015.

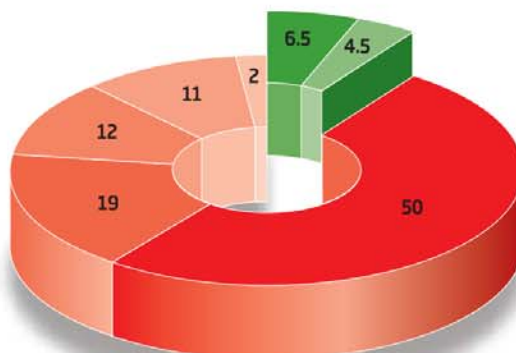
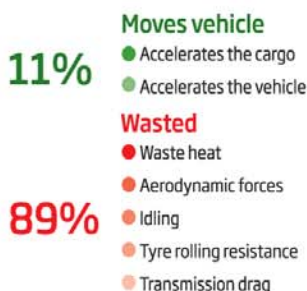
Truck-maker Mercedes-Benz recently claimed a world record for one of its Actros trucks, which achieved a fuel efficiency of 19.4 litres per 100 kilometres (12.1 miles per US gallon) when hauling a 25-tonne payload on a test track. This represents a halving of fuel consumption compared to the average for trucks on the road in the US and Europe today. It was achieved in part by fitting "superwide" tyres in place of pairs of conventional tyres, which spreads the weight and minimises friction with the road. Aerodynamic smoothing also played a part.

Even more ambitious innovations are on the way. The first diesel-electric hybrid trucks are already cruising the highway (See "Electric juggernauts", p 35), as are vehicles in which the diesel engine has been replaced by compact electric motors mounted inside the wheels (see "Drive wheel"). Other researchers want trucks to harvest energy from bumps in the road (see "Pothole power") or from waste heat in the engine's exhaust (see "Cool running").

One thing is for sure: though driven by different priorities, policy-makers, truck-builders and freight companies realise that things are going to have to change. Last year, the American Trucking Association launched a campaign to cut the US truck fleet's fuel consumption over the next decade by 318 billion litres through a combination of measures including streamlining and new engine technology.

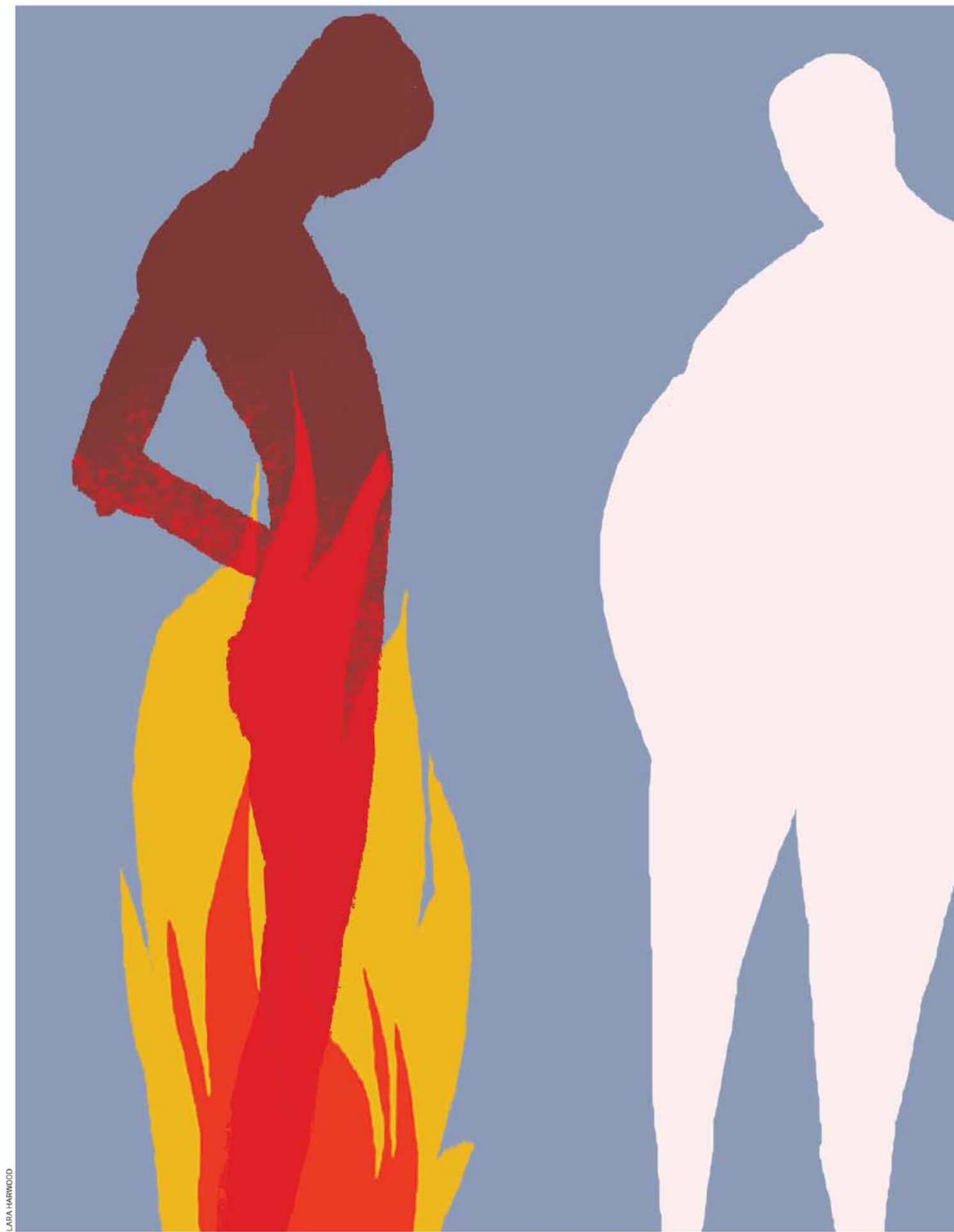
If only we had started earlier, says Lovins. "I think we'll look back in 2020 when we have tripled efficiency, and wonder what the heck took us so long." ■

Only 6.5% of the energy in a long-haul truck's fuel is used to shift the cargo inside it



SOURCE: ROCKY MOUNTAIN INSTITUTE

Phil McKenna is a freelance writer based in Boston



LARA HARWOOD



The fat that makes you thin

A curious kind of tissue that effortlessly burns up calories could be the answer to easy weight control. **Jo Whelan** investigates

IN THE war on our waistlines, fat is the enemy. It is fat, or adipose tissue, that gives us our beer bellies and our love handles, our man boobs and our muffin tops. And when plastic surgeons sculpt people into slenderness, it is fat tissue they suck up and throw out with the clinical waste.

It seems odd, then, that a type of fat tissue could also be the key to weight control. Not ordinary white adipose tissue, but a special kind called brown fat.

In some mammals, brown fat turns the energy obtained from food into heat, burning up calories without the animal expending any effort. It used to be thought that adult humans had no brown fat, but a raft of new evidence indicates that this is wrong, and it is in fact present and functional in at least some individuals. Differences in the amount of brown fat each person has may help to explain why some of us are slim while others are overweight, and why many of us pile on the pounds as we age.

Researchers are experimenting with

various ways to increase the amount or activity of our brown fat, either pharmaceutically or even surgically, by extracting ordinary white fat through liposuction, transforming it into brown fat and re-implanting it.

A mere 50 grams of brown fat – well within the range of what some of us already have – could dissipate around 500 calories a day. “I exercise on an elliptical trainer and it’s pretty hard for me to burn up 500 calories,” says Ronald Kahn, head of obesity research at Harvard Medical School’s Joslin Diabetes Center. “If I could do it without working and do it every day, it would be pretty great.”

Brown fat’s role in heat generation, also known as thermogenesis, has been extensively studied by animal physiologists. It turns out that brown fat cells have unusual mitochondria, the tiny structures found in almost all cells that release energy from food. In the vast majority of cells this energy is either stored or used to power cellular processes. The mitochondria in brown fat, however, contain a protein called thermogenin (or uncoupling protein 1), which causes energy to dissipate as heat. “This is a tissue whose sole purpose is burning energy,” says Francesco Celi, a researcher at the US National Institutes of Health.

As you might expect, this form of heat generation is important when it is cold, and as such might have been an important step in the evolution of mammals (see “Central heating for mammals”, page 41). In humans, it comes in useful for babies, who are prone to heat loss because their small size gives them a high

“This is a tissue whose sole purpose is burning energy”

surface-to-volume ratio and their temperature regulation systems are immature – they can't even shiver. Under the skin, babies have clearly visible deposits of brown fat, principally around the back, shoulders and neck.

By adulthood, however, things look very different. Autopsies of adults reveal, either no brown fat at all, or apparently insignificant traces within white fat. This led to the assumption that other tissues take over the role of heat generation when necessary. Muscles, for

example, can generate heat through shivering and also non-shivering thermogenesis. Clad only in hospital gowns, patients tended to get chilly during their scans. When the rooms were warmer the trouble spots disappeared. Radiologists came to suspect that they were seeing brown fat firing up in response to the cold.

Interest in brown fat picked up, and several groups began looking for the tissue more systematically in volunteers. A clutch of studies published in the past few months have shown that some people have small

but distinct islands of brown fat, each with a dense blood supply and nerve network. Analysis of tissue samples from the hotspots shows they contain thermogenin, the molecular hallmark of brown fat.

“Everyone would now unequivocally say that adult humans have brown fat, and that the brown fat can be active under normal circumstances,” says Ronald Kahn, who authored one of the papers (*The New England Journal of Medicine*, vol 360, p 1509). But not everyone has it. While only small numbers of people have been tested so far, researchers are starting to draw some tentative conclusions about who has the most.

Age is one factor. In a recent study, metabolically active brown fat was found in about half of subjects aged 23 to 35, but was present in only two out of 24 people aged 38 to 65 (*Diabetes*, vol 58, p 803). That team also found that people with less brown fat tended to be fatter.

Can we conclude, then, that brown fat protects against weight gain? “We cannot say anything about cause and effect,” says Jan Nedergaard of Stockholm University in Sweden, a veteran of brown fat research. It is possible, he points out, that being obese somehow leads to a decline in brown fat. Research in animals, however, supports the idea that a lack of brown fat may be a cause rather than a consequence of obesity. For example, mice that are genetically modified to lack thermogenin are more likely to become obese (*Cell Metabolism*, vol 9, p 203). “We believe it's probably the case that leanness is secondary to having greater amounts of active brown fat,” says Kahn.

It may be our genes that give some of us lucky tickets in this metabolic lottery and consign others to a lifetime of battling their weight. “We know that in some animals there seems to be a genetic difference in the amount of activatable brown fat the animals have,” says Kahn. “So I would think that the same is possibly true in humans.”

That raises the all important question: can we harness the power of brown fat to help overweight people trim their waistlines? This could, in theory, be done either by boosting the amount of our brown fat, or boosting its activity at normal, everyday temperatures – or preferably both.

Hormone replacement

Nedergaard believes the focus should be on preventing the decline in brown fat as people get older. “Most obesity appears in middle age and onwards, and this is when it seems brown fat activity starts to disappear,” he says. It might be possible to identify the cause of this decline and then reverse it, perhaps by replacing a lost hormone. What this hormone might be, though, remains a mystery.

Some existing diabetes drugs of the class known as glitazones, or thiazolidinediones, have been shown to increase the quantity

“Everyone would now say that adult humans have brown fat and that it can be active under normal circumstances”

example, can generate heat through shivering and also non-shivering thermogenesis.

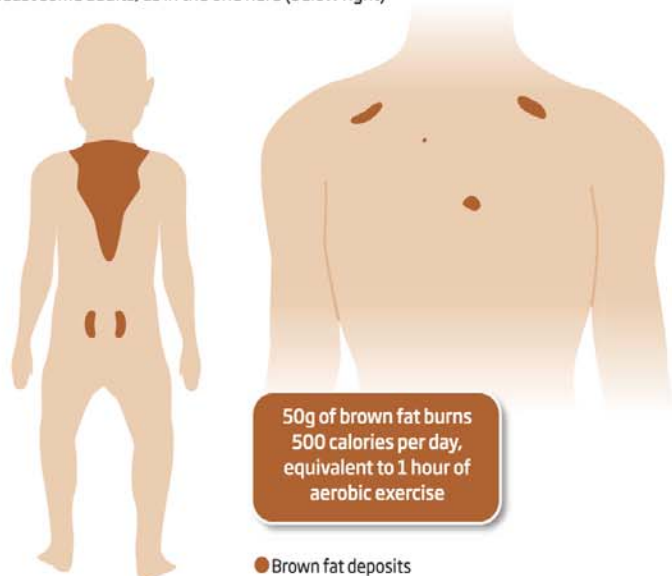
Then in 2002, a new way of looking inside the human body, called PET-CT scanning, threw up some odd results. The technique involves X-raying people after they have been injected with a radioactive tracer that picks up metabolic hotspots – a telltale sign of tumours. But the images were occasionally spoiled by constellations of bright spots around the collarbone, shoulders and back.

but distinct islands of brown fat, each with a dense blood supply and nerve network. Analysis of tissue samples from the hotspots shows they contain thermogenin, the molecular hallmark of brown fat.

“Everyone would now unequivocally say that adult humans have brown fat, and that the brown fat can be active under normal circumstances,” says Ronald Kahn, who authored one of the papers (*The New England Journal of Medicine*, vol 360, p 1509). But

Human hotspots

It was thought that only babies (below left) have brown fat, a special type of tissue that turns food energy into heat. New scans have revealed the tissue remains in at least some adults, as in the one here (below right)



CENTRAL HEATING FOR MAMMALS

Brown fat may have been one of the evolutionary adaptations that helped the first mammals exploit a new range of ecological niches, according to Jan Nedergaard and Barbara Cannon of Stockholm University in Sweden.

The tissue's heat-generating capacity results from mutations that gave rise to a protein known as thermogenin, or uncoupling protein 1, which probably occurred early in the evolution of mammals, they have speculated (*Physiological Reviews*, vol 84, p 277).

Thermogenin turns energy from food into heat.

Along with other adaptations that made us warm-blooded, thermogenin may have allowed the first small mammals to be nocturnal and to live in colder environments – thus reducing direct competition with cold-blooded reptiles.

"Brown fat opened this niche for mammals to be active during the night," says Nedergaard. "The ability to be going around and feeding when it's cold for other animals is clearly an advantage."

of brown fat in rats and to stimulate the formation of human brown fat cells in the lab. However, when used to treat diabetes they do not seem to activate brown fat, nor cause weight loss.

Another approach is to look at the mechanism that causes brown fat to be activated when an animal is exposed to cold. In animals and adult humans too, activation is triggered through the release of the hormone noradrenalin, which interacts with a receptor on the surface of the cells called the beta-3 adrenergic receptor. Rodents and dogs lose weight when given drugs that stimulate these receptors, but attempts to do the same for humans have shown a much smaller effect. Perhaps this is because most people have little active brown fat left.

If our natural stores of brown fat have dwindled, perhaps a more radical approach is needed. Although the work is still at an early stage, at least two groups are investigating ways of creating brown fat cells in the lab with the goal of surgically implanting them.

Kahn's team is focusing on a compound called bone morphogenetic protein 7, or BMP-7, also known as osteogenic protein 1. It is best known for promoting the formation of bone and cartilage, and a genetically engineered version is used in bone surgery. Last year, the group showed that if cells derived from mouse embryonic stem cells are treated with BMP-7 they turn into brown fat cells. When transplanted into a special breed of mouse that accepts tissue from unrelated individuals, they formed discrete islands of brown fat (*Nature*, vol 454, p 1000).

To test this approach in people, the team now plans to take white fat cells obtained through liposuction and treat them with BMP-7. The resulting brown fat cells could then be reimplanted into the original donor. "It's got a lot of potential," says Kahn.

Liposuction might not be the only source for brown fat cells though. In a paper that *Science* listed as one of the top 10 scientific breakthroughs of 2008, a team at Harvard Medical School showed that during embryonic

"The team plans to take white fat cells from liposuction, turn them into brown fat and re-implant them"

development, brown fat cells arise not from fat, but from muscle precursor cells (*Nature*, vol 454, p 961). The team also identified the command gene, called *PRDM16*, that switches these cells onto the brown fat development pathway. This is "the master regulator of brown fat", says Bruce Spiegelman, who led the research.

Last month, his team described taking skin cells from mice, switching on *PRDM16* and another gene, and transplanting the altered cells back into the same mice. On subsequent PET-CT scans, the mice had tiny hotspots where the tissue transplants had turned into islands of brown fat (*Nature*, DOI: 10.1038/nature08262). The researchers are now investigating whether a similar approach could be repeated in

people, as well as screening potential drug candidates for their ability to switch on *PRDM16*. "It's clear that these pathways exist in humans," says Spiegelman.

Manipulating brown fat, whether by drugs or surgery, may not be risk-free, however. By increasing energy expenditure you generate a high-flux metabolic state, points out Celi. This could increase our exposure to potentially harmful free radicals generated by the metabolism, which could conceivably cause cancer or even hasten ageing.

So instead of trying to artificially boost brown fat, with the attendant risk of side effects, why not just activate it by going out in the cold more, or turning down the heating? At first glance, the latter offers the tantalising possibility of helping to save both our waistlines and the planet.

We do not yet know, however, just how uncomfortably low indoor temperatures would have to dip to make a meaningful difference. Another unknown is whether cold-inducing stimulation of brown fat would cause any compensatory mechanisms to kick in. As Nedergaard points out, our natural response to being cold is to eat more – or put on a jumper.

Many other questions remain, but the old dogma that brown fat is either absent or has no physiological role in adult humans has been

overturned. This is likely to open up a whole new set of potential options for weight control. Could drugs that enhance brown fat one day be licensed for the treatment of obesity? If they are proved safe and effective will they eventually become available to those of normal weight in pursuit of the perfect figure?

The global rise of obesity is a hugely complex issue, involving not just biological factors but also social, economic and psychological ones. No one is suggesting that these could be cured by means of magic pills, but perhaps it's a case of "every little helps". As Spiegelman says: "We have the potential to develop a whole new approach to obesity." ■

Jo Whelan is a writer based in Oxford, UK

Reimagining the world

Generations of eco-artists meet in this exhibit, which reveals our fraught relationship with nature

Radical Nature: Art and architecture for a changing planet

Barbican Art Gallery, London. Until 18 October. Admission £8/£6 concs

Reviewed by Liz Else

ENTERING a giant space in a 1960s brutalist building, you nearly trip over a stuffed wolf on a trailer. Recovering, you spot an upended chunk of rainforest, puzzling trays of crops, a geodesic dome and plastic spheres tethered to the ground and draped with the air-growing plant *Tillandsia*.

Without reading the captions or the fat catalogue (recycled, of course), it is hard to construct a clear, coherent narrative out of this strange landscape. But maybe that is the point. Humans have long been caught up in a dark, often incoherent relationship

Agnes Denes stands amid her field of wheat in New York City

with the natural world. Nature and Culture came to exist only as idealised, dangerously opposed notions: pastoral fantasy versus harsh human progress.

Since the 1960s, we have had our collective environmental consciousness raised by David Attenborough, James Lovelock, Al Gore, Vandana Shiva and others. They and powerfully dystopian films and novels left us expecting the worst from Culture, while theorists such as Bruno Latour and Donna Haraway hacked away at our ideas about Nature.

Surely the point now should be to offer new answers to the question, what role can art and architecture play in a changing planet? Or are shows like this doomed to end up as beautiful, frustrating and beguiling, and as shot through with contradictions as their subject matter?

For instance, ironies and politics

pile up in Agnes Denes's 1982 work *Wheatfield – A Confrontation* (below). Denes planted wheat on New York City real estate worth billions. Spot the twin towers in the dense urban fringe – and note the harvest was fed to New York police horses. Trying to recreate the work on a scrap of forgotten land in industrial east London, however, only underlines the

“The point now should be to offer new answers to the question, what role can art play in a changing planet?”

monumental scale Denes worked with – and the large vision.

Younger artists seem weighed down by our troubled times. Does Argentinian Tomas Saraceno just want to float away altogether in **3x12MW*, his utopian vision of flying cells of conjoined cities? What are the French architects

who make up R&Sie(n) aiming for with *Symbiosishood 2009*, a building improbably designed for a former minefield on the border of North and South Korea, and covered with the fast-growing kudzu plant? Invisibility?

Sadly, Robert Smithson's amazing 1970 *Spiral Jetty* – a 457-metre “earthwork” on the Great Salt Lake in Utah colonised by salt crystals – is now threatened with real invisibility by a minerals company intent on exploitation.

Such ironies would be not be lost on the Center for Land Use Interpretation. Set up in 1994, it draws on scientists, geographers, social historians, artists, writers and lawyers to analyse the ways in which land is used. One result, a sort of “research as art”, is the oddly beautiful film *The Trans-Alaska Pipeline*. CLUI also run coach tours (to Smithson's Jetty among other sites) where their research is presented in situ.

Perhaps they should run trips to Indonesia, where architect Wolf Hilbertz's *Autopia*, a spiral-shaped island onto which material can accrete, is taking shape. Hilbertz has discovered that his structure can provide coral and other sea life with a new home. Give the man a prize for art – and saving coral! This is real radical nature.

There are important omissions, though. Buckminster Fuller's brand of utopianism has to be reflected in the show, but why no critique of another kind of utopian eco-craziness – the \$22 billion Masdar City in Abu Dhabi? And where's the biotech art? Can Day-Glo bunnies and victimless leather really be too radical? ■

Liz Else is an associate editor of *New Scientist*



AGNES DENES/COURTESY OF THE ARTIST



Photography: Ralph Morse/Life

Mailer's fire burns again

Norman Mailer, *Moonfire: The epic journey of Apollo 11*
by Norman Mailer and Colum McCann, Taschen, £650/\$1000

Reviewed by Adam Goff

THE 40th anniversary of the Apollo 11 moon landing has triggered numerous commemorative publications, a testament to the mission's technological achievement and cultural legacy. But none, I suspect, is as expensive or heavy, or as skilfully designed, researched

and packaged, as *Norman Mailer, Moonfire*, a collectors' edition of the author's writings on Apollo.

The book brings together hundreds of photographs, drawings and ephemera from the NASA archives – some familiar, others previously unpublished. Among them are amazing images from the now defunct US magazine *Life* by photographers such as Ralph Morse, who took the image above of the three Apollo 11 astronauts with their wives and children.

The text is taken from Norman

Mailer's musings on Apollo 11 in *Life* as well as excerpts from his book on the mission, *Of a Fire on the Moon*, first published in 1970 and now out of print.

In 1969, Mailer was one of the most celebrated and controversial authors in the US. He roamed NASA, recording the people and processes that converged to put astronauts on the moon. Remarkably for Mailer, whose self-regard was legendary, the first chapter in *Of a Fire on the Moon* is entitled "A loss of ego". A quote from the author published in

1969 goes some way to explaining: "I began to realise that the moon landing was an event no man could ever dominate with his ego, and I realised I was going to have to work 20 times harder on the book than I thought I would... There are areas of ambiguity about the landing on the moon at least as large as when Columbus came back from the discovery of the new world."

Taschen is printing only 1969 copies of *Moonfire*, 12 of which come complete with fragments of moon meteorite. ■

Not the naked ape

The gulf between humans and other primates grows wider the closer you look



PLUSHSTUDIO/GETTY

Not a Chimpanzee: The hunt to find the genes that make us human

by Jeremy Taylor, Oxford University Press, \$27.95/£16.99

Reviewed by Ewen Callaway



AFTER a pet chimpanzee named Travis severely mauled a Connecticut woman in February, police wanted an explanation.

Perhaps the ape didn't recognise the victim – who he knew well – because of a new haircut. Maybe Lyme disease or an anti-anxiety drug sparked the attack.

What else could explain such savage behaviour from a creature who shared 98.4 per cent of his DNA – and the odd glass of wine – with his human keepers?

Nonsense, argues Jeremy Taylor in his takedown of such anthropomorphic attitudes. In this book, his first, the former BBC producer synthesises recent

genetic, behavioural and neuroscientific research to argue that far more than a handful of genes divides humans from our evolutionary cousins, 6 million years removed.

Take that 98.4 per cent, an oft-repeated figure that has been used to argue that chimps deserve human rights. True, *Homo sapiens* and *Pan troglodytes* share an extraordinary amount of genetic similarity – yet humans and mice share almost as much.

Complete genomes of both species are enabling researchers to map the chasm between human and chimp, which seems to deepen by the year. A good example is *FOXP2*, a regulatory gene linked to speech and language disorders in humans. *FOXP2* in chimps has barely changed in the 130 million years since primates and mice diverged from their common ancestor. But after humans and chimps split, two key changes accumulated on the human line.

Even greater differences may lurk in the areas of the genome once discounted as “junk” DNA, which don't make proteins but instead determine gene activity. One recently discovered RNA-coding sequence that may be involved in cerebral cortex development was found to vary little between chimps and chickens, yet humans possess 18 unique changes.

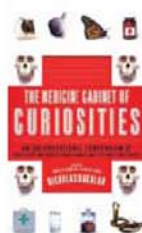
Geneticists are right to home in on differences that affect brain development: nowhere is the gulf between humans and chimps wider than in their mental abilities. Psychologists suggest that the ability to infer the mental states of others may underlie language and culture. Children gradually acquire this capacity, called theory of mind, but evidence for it in chimps is equivocal.

From a scientific perspective, however, Taylor's polemic takes on a straw man. Most primatologists and psychologists are conservative in their assessments of chimp abilities, and geneticists freely admit how little they know about what separates the two species. Instead, *Not a Chimpanzee* should be mandatory reading for journalists who often reinforce the general public's misconception that chimps are practically human.

Sage advice

The Medicine Cabinet of Curiosities: An unconventional compendium of health facts and oddities, from asthmatic mice to plants that can kill by Nicholas Bakalar, Henry Holt & Co, \$15

Reviewed by Jonathan Beard



AN IDEAL choice for your next doctor's appointment, this book will provide entertainment, useful health information and some reassurance while you wait to be called.

You'll learn you do not have Ebola haemorrhagic fever, for

example, by checking the list of dire symptoms. Bakalar provides many such lists and interesting snippets. Why is it, for example, that although the human body contains 10 times as much silicon as iron, no one ever takes silicon supplements?

If you happen to be waiting for a new organ, consider that 40,000 corneas, 16,000 kidneys and 6500 livers change hands every year. And, remarkably, about 40 people have received new hearts from living donors: someone with bad lungs but a healthy heart can get both from a cadaver – less risky than transplanting lungs alone – then pass their own heart along.

Looking twice

Something Incredibly Wonderful Happens: Frank Oppenheimer and the world he made up by K.C. Cole, Houghton Mifflin Harcourt, \$27

Reviewed by Dan Falk



WHILE Robert Oppenheimer is forever linked to the atomic bomb, his younger brother Frank is less well known. Like Robert, he

worked on the Manhattan project and was persecuted for suspected communist sympathies. Frank's career eventually recovered – unlike his brother's – and after a stint as a Colorado rancher he returned to academia and later founded the Exploratorium in San Francisco. He supervised the development of this unique interactive science museum from its conception in 1969 until his death in 1985.

K.C. Cole brings the quirky, cane-thumping scientist to life in this entertaining biography. His playful approach to science was infectious, Cole says. “Through his eyes, we all became 3-year-olds again, looking at old things afresh and finding universes we'd never known existed.”

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BIOLOGY

Associate Microbiologist Professional (090420)

Allergan

MS - Mississippi

Must be able to function in a diverse environment which requires applying a comprehensive knowledge of microbiological systems in pharmaceutical products (oral, topical, ophthalmic and injectable).

For more information visit
NewScientistJobs.com Job ID:
200511710

Research Associate II - Gene Regulation Drug Discovery

City of Hope

CA - California

A Research Associate II is sought to investigate novel mechanisms of metabolic regulation in heart and skeletal muscle by a family of orphan nuclear receptors in regulating muscle growth and energy metabolism.

For more information visit
NewScientistJobs.com Job ID:
200507487

Associate Anatomical Pathologist

Covance US

WI - Wisconsin

Provide support services to Pathology commensurate with current knowledge of veterinary/toxicologic pathology. Attend necropsies as required and provide scientific guidance to necropsy and histology technicians to ensure accuracy and compliance with protocols and SOP's.

For more information visit
NewScientistJobs.com Job ID:
200512071

Biostatistician

Covance US

WI - Wisconsin

Preparation and review of Statistical Analysis Plans with appropriate guidance from other statistical staff.

Perform QC of analysis datasets and data displays for secondary efficacy and safety variables.

For more information visit
NewScientistJobs.com Job ID:
200512648

Medical Director

Covance US

PA - Pennsylvania

Serves as project physician and provide medical/scientific expertise to our clinical project teams. Develop, review and revise protocols, CRFs, training materials, project specific tools, medical responsibility plans, analysis plan design, clinical trial reports and NDAs.

For more information visit
NewScientistJobs.com Job ID:
200510685

Veterinarian

Covance US

VA - Virginia

Nonclinical testing is conducted throughout all phases of drug development and, when done well, can maximize the chances of success in the clinical phases.

For more information visit
NewScientistJobs.com Job ID:
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Associate Scientist - Bioinformatics

Genentech

CA - California

The successful candidate will collaborate with our experimental biologists in studying various aspects of cancer biology including cancer stem cell research and molecular diagnostics.

For more information visit
NewScientistJobs.com Job ID:
200513720

Postdoctoral Research Fellow

Genentech

CA - California

We are seeking a motivated, collaborative researcher for a

Postdoctoral training position in the Stern Lab to study mechanisms of human epidermal growth factor (HER, ErbB) signaling and mechanisms of resistance to HER targeted therapies.

For more information visit
NewScientistJobs.com Job ID:
200513249

Research Associate

Genentech

CA - California

The Research Associate will work in Molecular Biology department supporting the development, characterization and application of genetically modified murine models of cancer.

For more information visit
NewScientistJobs.com Job ID:
200513702

Scientist- Neuroscience

Genentech

CA - California

We are seeking a highly motivated neuroscientist to join our efforts in developing therapeutics for neurodegenerative and neuropsychiatric indications.

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NewScientistJobs.com Job ID:
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Faculty Research Positions in Ophthalmology

Medical College of Wisconsin

WI - Wisconsin

A strategic focus of the Vision Science program is to build upon an already strong group of investigators by recruiting up to 3 new faculty members in the Department of Ophthalmology.

For more information visit
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Scientist I/II (Drug Delivery/ Device Scientist)

Medimmune US

MD - Maryland

Working within the Device and Drug Delivery Development group you

will evaluate and develop internal and external technologies that have potential application to biological drug delivery.

For more information visit
NewScientistJobs.com Job ID:
200508645

Scientist II/ Senior Scientist, Pharmacokinetics

Medimmune US

MD - Maryland

The scientist (pharmacokineticist) functions as the Global PK-PD&B project leader and team representative for biotherapeutic products at various stages of research and development.

For more information visit
NewScientistJobs.com Job ID:
200508646

Clinical Research Coordinator

Memorial Sloan-Kettering Cancer Center

NY - New York

Memorial Sloan-Kettering Cancer Center is a world renowned organization dedicated to the progressive control and cure of cancer through programs of patient care, research, and education.

For more information visit
NewScientistJobs.com Job ID:
200512326

Post Doctoral Fellow, MRI Research

NorthShore University Health System

IL - Illinois

Join NorthShore Research Institute, ranked among America's top 10 comprehensive independent research hospitals and number one in the state of Illinois by the National Institutes of Health (NIH). The Research Institute currently has a Post Doctoral Fellow Research position in cardiovascular MRI technology development in the Center for Advanced Imaging (CAI). The candidate will work as part of a group of enthusiastic scientists, physicians, technologists, and research coordinators to



Database Analyst/Postdoc:

The Department of Pathology at UT Southwestern Medical Center (Dallas, TX) is seeking one or more database analysts or postdoctoral fellows for an NIH-funded Bioinformatics Resource Centers for Infectious Diseases (BRC) project (see www.biohealthbase.org for more information) that will be undergoing a major expansion to cover most human pathogenic viruses. The candidate must have a working knowledge of bioinformatics related to genomics and/or proteomics data, and of public database resources such as NCBI Entrez/GenBank. Laboratory research experience in virology, immunology or related disciplines, especially related to NIH-defined Category A – C viral pathogens (www3.niaid.nih.gov/topics/emerging/list.htm) is preferred. Relevant bioinformatics training will be provided.

This individual will be a member of the research team responsible for the development, maintenance and extension of the Virus Pathogen Database and Analysis Resource BRC. The candidate will spend ~30% effort interacting with the scientific user community through various outreach activities in order to capture system requirements and to assess database needs, therefore strong interpersonal and communication skills are required. The other 70% effort will be spent on the following:

- Identifying public sources of relevant data
- Manual curation of the scientific literature
- Conceptual design of database models
- Conveying user requirements and design concepts to a team of software engineers in order to facilitate system development activities
- Performing complex data mining analysis related to comparative genomics and phylogenetic evolution
- Host-pathogen systems analysis

To apply, send a current C.V./resume and three reference letters to Dr. Richard H. Scheuermann (victoria.hunt@utsouthwestern.edu). Also, please apply on-line at www.utsouthwestern.edu/careers.

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conduct research concerning the development and use of magnetic resonance for cardiovascular imaging. One research topic of emphasis will be the development of new technologies for magnetic resonance angiography (MRA) without the use of exogenous contrast material. Qualifications: The candidate must hold a Ph.D. in biomedical engineering, medical physics, or a related field, and must have at least 1-2 years of experience with MRI physics as well as 1-2 years of experience in MRI pulse sequence programming in C/C++ (preferably on Siemens MRI systems; IDEA/ICE). The candidate must have strong written and communication skills and should have a demonstrated ability to publish manuscripts in peer-reviewed journals. The candidate should also be legally authorized to work in the United States. Facility and Equipment: The CAI is a 10,000 square foot imaging research facility that is equipped two state-of-the-art 32-channel MRI scanners (1.5 T Siemens

Avanto and 3T Siemens Trio). The center houses a dedicated image processing laboratory, a RF coil lab, ancillary facilities for animal studies, as well as extensive office space. NorthShore Research Institute is the research arm of NorthShore University HealthSystem (formerly Evanston Northwestern Healthcare), a fully integrated, multi-hospital healthcare system serving northern Chicago, Illinois. We are affiliated with the University of Chicago's Pritzker School of Medicine, one of the premiere medical schools in the country, creating a dynam

For more information visit
NewScientistJobs.com Job ID:
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Research Study Assistant

Memorial Sloan-Kettering Cancer Center
NY - New York

As an integral member of the research team and in compliance with all regulatory, institutional, and departmental requirements,

performs data collection and data entry and participates in data analysis for protocol/non-protocol studies within MSKCC.

For more information visit
NewScientistJobs.com Job ID:
200512325

In Vivo Target ID Validation Lab Leader, R5-R6 (Oncology)

Pfizer US
CA - California
Through collaborations and internal efforts, apply molecular genetic and pharmacology approaches to functionally identify and validate cancer targets using advanced in vivo models of disease.

For more information visit
NewScientistJobs.com Job ID:
200514610

Associate Director, Strategic Alliances - Oncology

Novartis Institutes for BioMedical Research (US)
MA - Massachusetts

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Drug combination studies	Neuropharmacology
Gene therapy	Platelet biology
Growth regulation	Signal transduction
Immunobiology	Stem cell biology
Molecular biology	Structural biology
Molecular microbiology and pathogenesis	Thrombosis and hemostasis
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Musculoskeletal biology	Viral oncology

Positions may be available in any of several basic science departments and/or research programs and institutes.

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To submit curriculum vitae or to request further information about a faculty position, please contact the **Associate Dean for Faculty Affairs, Temple University School of Medicine, 3500 North Broad Street, Room 1111K, Philadelphia, PA 19140.**



Temple University is an affirmative action/equal opportunity employer and strongly encourages applications from women and minorities.

Further information about Temple University School of Medicine is available at <http://www.medschool.temple.edu/>

The Associate Director, Strategic Alliances - Oncology will proactively identify, evaluate, and negotiate transactions for Oncology research.

For more information visit
NewScientistJobs.com Job ID:
200511841

Marketing, Lipitor team

Pfizer US
NY - New York
Execute strategic marketing initiatives to enhance Lipitor's customer value proposition - Develop creative and strategic insights about customer needs through collaboration with medical, market analytics and sales colleagues as well as directly with prescribers

For more information visit
NewScientistJobs.com Job ID:
200514463

Senior Scientist

Novartis Institutes for BioMedical Research (US)
NJ - New Jersey

Perform routine tasks including set up, conduct, data analyses and report for telemetry studies in safety pharmacology and toxicology studies.

For more information visit
NewScientistJobs.com Job ID:
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Limited Term-Post Doctoral Research Scientist

Pioneer Hi-Bred
 DE - Delaware

The Post-doctoral Research Scientist will focus research on plant abiotic stress tolerance using the model plant Arabidopsis. The goal of the project is to determine the molecular mechanisms by which plants cope with adverse environments.

For more information visit
NewScientistJobs.com Job ID:
200512541

Scientist, Oncology

Pfizer US
 CA - California

We are seeking a talented scientist to join our efforts in the discovery and development of novel protein therapeutics for cancer treatment.

For more information visit
NewScientistJobs.com Job ID:
200511970

Clinical (Drug Development) Continuous Improvement Specialist - (Associate Dir - D4 / Director - D5)

Pfizer US
 CT - Connecticut

The purpose of the CI Specialist position is to provide Continuous Improvement (CI) expertise (e.g. Lean, Six Sigma, DFSS) and aid in embedding a CI culture within Development Operations.

For more information visit
NewScientistJobs.com Job ID:
200511967

Cancer Genetics R5/R6 (Oncology)

Pfizer US
 CA - California

Apply a wide variety of -omics assay technologies to establish molecular characteristics of cancer tissues and cells under different conditions.

For more information visit
NewScientistJobs.com Job ID:
200514706

Medical / Development Lead

Pfizer US
 NY - New York

Accountable for overall medical development strategy for the asset and establishing aligned medical/development plan in collaboration with cross-functional stakeholders within the CDMA, partner lines, commercial development and other key stakeholder groups.

For more information visit
NewScientistJobs.com Job ID:
200510667

Senior Manager/Director, Healthcare Professional Discovery Post Doc

Pioneer Hi-Bred
 CA - California

Perform plant mutant library screening and gene isolation. Examine the functionality of mutant genes using biochemical or transgenic approach.

For more information visit
NewScientistJobs.com Job ID:
200512562

Research Assistant

Pioneer Hi-Bred
 HI - Hawaii

Duties include, but may not be limited to: harvesting, selecting and treating corn ears in the laboratory; plant tissue culture; media prep; data input with computer; print labels; instrument and equipment maintenance; hazardous waste disposal.

For more information visit
NewScientistJobs.com Job ID:
200512539

Senior Research Associate

Pioneer Hi-Bred
 IA - Iowa

Assist in the development and deployment of analysis methods for genetic evaluation, gene detection, and prediction of inbred line and hybrid trait performance by using advanced statistical and computational approaches.

For more information visit
NewScientistJobs.com Job ID:
200509609

Assistant Professor in Cellular Microbiology, The Division of Basic Biomedical Sciences

Sanford School of Medicine of The University of South Dakota
 SD - South Dakota

Applicants must have a Ph.D. and/or M.D., or equivalent degree, and post-doctoral experience. Successful candidates will be expected to develop an independent, externally funded research program investigating the host-pathogen interface.

For more information visit
NewScientistJobs.com Job ID:
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Postdoctoral Research Associate or Visiting Research Specialist

University of Illinois at Chicago
 IL - Illinois

This position will involve the performance of drug metabolism and pharmacokinetic assays in support of early to late drug discovery projects for tuberculosis.

For more information visit
NewScientistJobs.com Job ID:
200510879

CHEMISTRY

Synthetic Chemist

Pfizer US
 MA - Massachusetts

This position seeks a synthetic/medicinal chemist to conduct organic synthesis research on the design, execution, and interpretation of reactions and synthetic sequences aimed at preparing novel DNA and RNA mimics.

For more information visit
NewScientistJobs.com Job ID:
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CLINICAL

Clinical Trial Manager II

Genentech
 CA - California

The Clinical Trial Manager II is accountable for the day-to-day operations of 1-4 clinical trials

commensurate with complexity, including trial start-up, conduct, and close-out activities.

For more information visit
NewScientistJobs.com Job ID:
200513674

Clinical Data Manager 1

Covance US
 NJ - New Jersey

The Clinical Data Manager will develop and maintain a close liaison with project client contacts, core team members, and Project Managers to drive the data management aspects of project delivery.

For more information visit
NewScientistJobs.com Job ID:
200513102

Biologics Professional (Research Associate) (090315)

Allergan
 MS - Mississippi

Performs routine and non routine biological and chemical testing of biopharmaceuticals, biologic reagents and reference standards according to established Standard Operating Procedures and Specifications.

For more information visit
NewScientistJobs.com Job ID:
200511706

Director - Clinical Research Regulatory Support Services - CTO

City of Hope
 CA - California

The Director of Clinical Research Regulatory Support Services will be responsible for the direction, oversight and supervision of the regulatory support unit within the Office of Clinical Research Operations.

For more information visit
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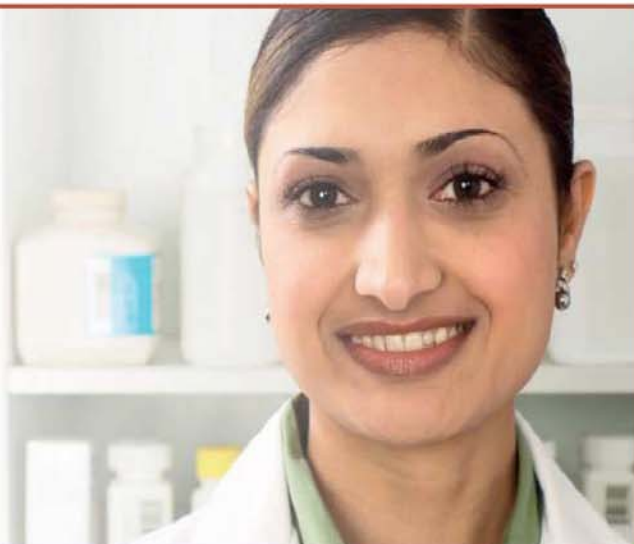
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Boeing
 WA - Washington

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methodologies. Participates as a member of an Integrated Product Team (IPT) in the integration of technical solutions.

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Director, Tactical Systems

Boeing
CA - California
Lead a multi-program AS9100 Team to provide Engineering, Field Support & Multi-INT System Integration of National, Strategic & Tactical ISR systems to enhance the battlefield situational awareness of the warfighter.

**For more information visit
NewScientistJobs.com Job ID:
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Quality Engineer (090429)

Allergan
CA - California
Under general guidance, the Quality Engineer will help lead

design control activities, perform product qualification, highly complex engineering duties associated with equipment qualification, process development and validation, and test method development and validation.

**For more information visit
NewScientistJobs.com Job ID:
200511634**

Engineering Multi-Skill Manager L SO-MO-BD

Boeing
CO - Colorado
The candidate will lead a technically diverse engineering and operations team across several geographic Boeing locations to develop, test, and integrate ground control system/Satellite Ops Center for the Space Based Space Surveillance Program.

**For more information visit
NewScientistJobs.com Job ID:
200508768**



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UNIVERSITY OF CHICAGO Department of Chemistry – Assistant Professor



The Department of Chemistry of the University of Chicago invites applications from outstanding individuals for the position of Assistant Professor of Chemistry. This search is in the areas broadly defined as inorganic, organic, and physical chemistry. Applicants must apply on line at the University of Chicago academic job website at <https://academiccareers.uchicago.edu>. Applicants must upload a cover letter, a curriculum vitae with a list of publications, and a succinct outline of research plans. The cover letter should be addressed to the Inorganic Search Committee, Organic Search Committee, or Physical Search Committee, depending on the applicant's discipline of interest. Applicants must also arrange to have three letters of recommendation sent to the Department of Chemistry, Office of the Chairman (SCL 119), The University of Chicago, 5735 S. Ellis Ave., Chicago, IL 60637. The recommendation letters will be accepted by mail only. Review of completed applications will begin October 1, 2009; to ensure full consideration, all material should be submitted by that date.

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SALLIE ROSEN KAPLAN FELLOWSHIP FOR WOMEN IN BASIC, CLINICAL, EPIDEMIOLOGICAL OR PREVENTION SCIENCE

The Sallie Rosen Kaplan Fellowship for Women Scientists in Cancer Research is made possible by a generous bequest to the Foundation for NIH (FNIH). This is a competitive program for female postdoctoral fellows applying to train in any of the National Cancer Institute's intramural research settings, including basic, clinical, epidemiological, and prevention science.

The postdoctoral fellowship experience at the NCI can serve as a first postdoctoral training assignment, or offer more experienced postdoctoral scientists an opportunity to further their training in more advanced methods, to acquire new research capabilities, to make changes in the direction of their research, or to receive training in fundamental sciences and clinical disciplines for the purpose of enhancing the transfer of biotechnology to cancer clinical programs.

Program duration is normally 2 to 5 years. Fellows will be supported by a Cancer Research Training Award (CRTA), with an augmented stipend in the first year provided by the FNIH. The CRTA Fellowship stipend range is \$44,600 to \$82,400 commensurate with level of experience. Standard self and family health insurance is provided and high option coverage is available.

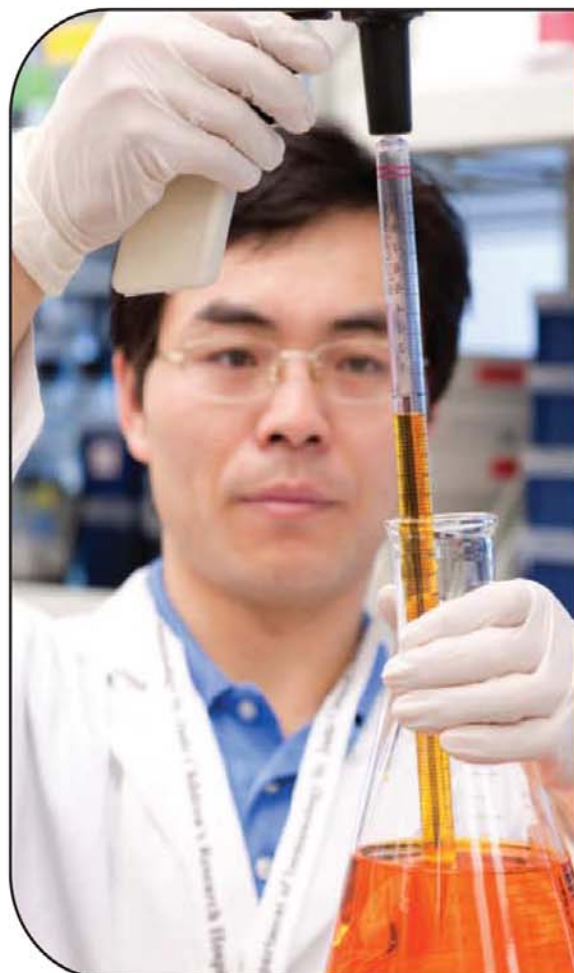
Candidates for the Sallie Rosen Kaplan Fellowship must be female, must possess a doctoral degree, and must have less than 5 years postdoctoral research experience. U.S. citizenship or U.S. permanent residency (green card) is required. Finalists for the Kaplan fellowship will be notified by March 2010 and winners announced by May 2010. To be eligible for the Sallie Rosen Kaplan Fellowship award, the starting date of any NCI fellowship must be no earlier than December 14, 2009. Applicants are required to apply online at <http://www.training.nih.gov/apps/publicForms/postdoctoral/forms/adIndex.aspx> by December 11, 2009. Additional information about the Kaplan Fellowship can be found at <http://www.cancer.gov/researchandfunding/training/srk>

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Candidates receiving offers of employment will be subject to pre-employment drug testing and background checks. Federal law requires all employers to verify the identity and employment eligibility of all persons hired to work in the United States. To support this mandate, St. Jude Children's Research Hospital participates in E-Verify.



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Post Doctoral Position

A Postdoctoral position in electrophysiology is available to study the regulation of ion channels by protein kinase C isozymes in models of chronic pain and addiction. The position is in the laboratory of Dr. Robert O. Messing at the Ernest Gallo Clinic and Research Center, Department of Neurology, University of California San Francisco (UCSF). Applicants must hold a Ph.D. or M.D. degree and have had training in whole cell patch clamp recording.

If you're the right fit for this position, please send a CV, description of prior research and names of at least two academic referees in MS Word format to hr@gallo.ucsf.edu and reference "PDF-RM" in the subject line of your email.

Programmer Analyst

The Ernest Gallo Clinic and Research Center, an Emeryville, CA-based not-for-profit research institute, has an immediate opening for a Programmer Analyst in the laboratory of Dr. Eric Jorgenson. Candidate will work with researchers to assist with the design or adaptation of existing software to integrate and analyze data generated from large scale genomic experiments.

Requires a Master's degree in computer science or equivalent and a minimum of four years of experience; knowledge of the properties of DNA and genotyping assay; knowledge of Microsoft.Net, SQL, Access and Java to create databases and to develop software for automated data processing, automated data analyses and generation of reports; computer programming skills including experience in Java, Microsoft, SQL, C/C++, Oracle PL/SQL, awk, sed, grep, TeX/LaTeX, Perl, and Python; ability to understand the needs of biologist and human geneticist and to develop software to meet those needs; ability to integrate the output from various platforms; ability to write software to analyze high throughput data automatically; ability to understand all the steps involved in the experimental process, be familiar with the data structure of the output from the sequencers and plate readers, and knowledgeable of reporting requirements of the investigators; ability to write code for ease in statistical analyses.

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COMPUTER scientists are not the only researchers whose inboxes fill up with invitations to submit papers to previously unheard-of conferences, but they probably get more than most. Researchers Jeremy Stribling, Max Krohn and Dan Aguayo at the Massachusetts Institute of Technology were so annoyed at what they dubbed “spamferences” that they did what computer scientists might have been expected to do: they wrote a program called SClgen that generates random papers and submitted the papers to random conferences.

Some might say that the computer field is particularly susceptible to this prank. The first paragraph of one of the machine-written papers contains the memorable, if puzzling, phrase: “The notion that end-users synchronise with the investigation of Markov models is rarely outdated.” To explain to the uninitiated precisely why this is

rubbish would take most of this page. Nevertheless, the paper, randomly entitled “Rooter: a methodology for the typical unification of access points and redundancy”, was accepted by the 2005 World Multi-Conference on Systemics, Cybernetics and Informatics in Orlando, Florida.

The SClgen team raised the \$390 conference fee in donations. The conference returned this on discovering that the paper was a fake, but the team went to the conference venue anyway and, in another room in the hotel, presented three randomly generated papers that they themselves had not seen until they appeared on the screen in front of them. You can see a video of this, and download the program, at www.pdos.csail.mit.edu/scigen.

Then the project went international. In Russia, candidates for doctoral degrees have recently been obliged to have their

research results published in an accredited refereed journal. As if by magic, the *Journal of Scientific Publications of Aspirants and Doctorants* appeared, under the editorship of a lawyer from Kursk. It advertised itself with internet forum postings supposedly from satisfied authors.

Mikhail Gelfand, professor of bioinformatics at Moscow State University, was not pleased or convinced by this new journal, so he translated the SClgen “Rooter” paper into Russian, added some Russian references and submitted it to the journal on 6 August last year. The following day the journal requested payment – in advance of the reviewer’s comments on 13 August and the paper’s acceptance on 15 August. If only genuine scientific publishing were so swift.

Following a small media storm in Russia, the journal was officially de-accredited two weeks later. Result!

More fun followed. Earlier this year, Philip Davis of Cornell University in Ithaca, New York, produced another random paper, “Deconstructing access points”, and pretended it was by researchers at the fictitious Center for Research in Applied Phrenology (CRAP). *The Open Information Science Journal* accepted the paper, asking a mere \$800 for publication – see “CRAP paper accepted by journal” at www.oisj.notlong.com (*New Scientist* online, 11 June).

And what computer program did Davis turn to for help in generating his random paper? Why, SClgen, of course.

STRUCK by a *New Scientist* report on the sin nombre virus (4 July, p 12), Steve Gissebrecht points out that “sin nombre” is Spanish for “without a name”.

“So is it or isn’t it?” he asks.

He goes on to place the virus in the same category as the brain structure called the “*substantia innominata*” (“unnamed substance”) and finishes

with the dangerous request “Any others?”

Here a voice deep inside Feedback’s nether being cries out “Nooooo!” Our mention of No Name Street and Sans Nom Road on 21 January 2006 led to one of our heaviest-ever postboxes, with an avalanche of nameless streets, villages called Nowhere and a No Name restaurant in Boston appearing in both Feedback and Letters in subsequent issues until we begged for mercy. Not again. Please.

AFICIONADOS of biblical miracles will no doubt be out in force in the east of England in late September. Steve Plater tells us that according to the Cambridge alumni weekend brochure: “To commemorate the 900th



anniversary of the creation of the diocese of Ely... the bishop of Ely will be walking from Ely to Cambridge along the river Cam on Sunday 27 September.”

FINALLY, health products chain Holland and Barrett’s flaxseed oil supplement comes in two strengths. The 1000-milligram capsules carry the advice: “Take one capsule twice a day... Do not exceed stated dose.” The advice for the 500-milligram capsules is: “Take one capsule twice daily... Do not exceed stated dose.”

You can send stories to Feedback by email at feedback@newscientist.com. Please include your home address. This week’s and past Feedbacks can be seen on our website.

Paul Burkimsher received an official letter from the University of Wuhan in China, addressed to him at “CERN, the European Organisation for Unclear Research, Geneva”

Blow hole

What is the purpose of the small hole halfway down the outside shell of a Bic ballpoint pen?

■ If the inside of a ballpoint pen were entirely airtight, the pressure inside it would fall as the ink was used up. This would slow or stop the flow of ink because the higher air pressure outside the pen would push the ink back in.

The reverse could happen if the pen were heated. This would cause the ink to leak out of the pen (presumably onto your most expensive jacket). The hole is there to allow the air pressures to equalise and prevent these problems.

Simon Langley
Ilkley, West Yorkshire, UK

Sven Taylor of Riedisheim, France, took the question to the manufacturer's French factory. Here is the answer he received – Ed

■ The hole is to equalise the pressure inside the pen with the pressure outside the pen. These vents, or holes in the pen barrels, basically help to prevent ink leakage. Approximately 90 per cent of all pens are vented to prevent leakage. Pens that do not have vented caps contain sealed ink systems and must be pressurised. See www.bicworld.com/inter_en/stationery/faq.
Soci   Bic
Communication Department
Clichy, France

Fly trap?

When my family returned from a two-week holiday during the summer, we found a cluster of dead flies stuck to our porch window. Each was surrounded by a hazy mist on the glass. We have lived in our house for 20 years and we have never seen this before. Even after two weeks, when the photograph (below) was taken, nothing had changed. The flies hadn't moved and no predator had come to eat them. Can anyone explain what has happened?



■ The flies are almost certainly affected by the parasitic fungus *Entomophthora muscae*, which infects and kills domestic flies, *Musca domestica*. Infected flies are forced to land while the fungus grows inside the abdomen, causing it to swell. Finally the fungus breaks out and causes the mist-like structures seen on the window.

Infected female flies with swollen abdomens are especially attractive to male flies, which try to mate with what they think are

fecund females. The disease then spreads from female to male, and the greater the population, the faster it spreads.

David Fleet
S  derstapel, Germany

■ The flies show typical symptoms of infection by an entomopathogenic fungus. The white halo around each dead fly is a deposit of the forcibly discharged infectious fungal spores.

When one of these spores touches a live fly it germinates and penetrates the cuticle. The fungus then grows internally until the fly's body is full of fungal cells. The infected fly becomes sluggish, comes to rest and dies. If the humidity is high enough the fungus then grows out of the intersegmental membranes, incidentally gluing the dead insect more firmly to the windowpane, and fires off a fresh round of spores.

Some fungal species alter the behaviour of the host insect, causing it to die in an unusually elevated position, which improves the chances of a spore hitting a fresh host. A striking example is *Entomophaga grylli*, which infects grasshoppers and causes "summit disease", where the infected insects climb to the tops of grass stems to shower spores on the population below.

Under humid conditions, entomopathogenic fungi can cause impressive epidemics in insect populations. The very wet northern summer of 2008 would have been favourable for

infection, and I found several infected flies in my garden.

Chris Prior
Bampton, Devon, UK

Thanks to Luce Gilmore from Cambridge, UK, for this website that provides more information on *Entomophthora muscae*: www.hort.wisc.edu/mastergardener/features/insects/entomophthora/entomophora.htm – Ed

This week's question

WINE ON THE LINE

Since my 20s, I have drunk on average a bottle of wine a day. I'm now 57. That's 49 UK alcohol units a week. The UK's recommended weekly limit for a man is 28 units. I recently had a complete health check at my local clinic, and I'm in perfect health. Specifically, my liver function tests are entirely normal. Am I exceptional or are the government limits spurious?

I rarely drink spirits and occasionally substitute beer for wine. I play football and squash. I walk 3 kilometres to and from work. I lead a normal life and, probably due to regular consumption, I never feel drunk, but presumably I am considered a binge or problem drinker. I don't want advice from a government minister or associated medic. I want objective information. Am I just lucky? Or is my consumption relatively harmless? What's the truth?

David Hunte
London, UK

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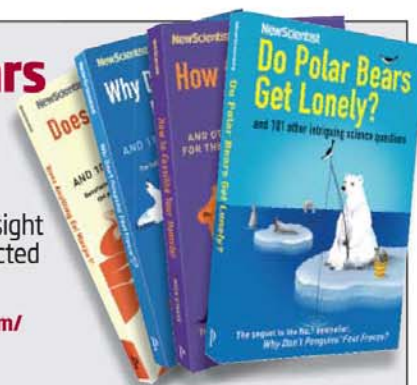
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For a list of all unanswered questions send an SAE to LWQlist at the above address.

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